University of Split

Faculty of Civil Engineering, Architecture and Geodesy

SYLLABUS FOR THE ACADEMIC YEAR 2015/16 OF THE POSTGRADUATE

UNIVERSITY DOCTORAL STUDY

Civil Engineering

Split, 6th May 2016

SYLLABUS

Postgraduate University Doctoral Study of Civil Engineering

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1. Programme description

1.1. Structure and organisation of the study programme

The study programme is organised as full-time study and lasts from three to four years (eight semesters) or as a part-time programme which lasts six years (12 semesters), during which the student collects the minimum of 240 ECTS credits. Exceptionally, according to the Ordinance, the maximum duration for the full-time study programme is six years and eight years for the part-time programme. Compulsory and elective classes are carried out during the first two semesters. Last three years are exclusively scheduled for research-related activities, i.e. writing of the dissertation. From the total of 240 ECTS credits, 60 ECTS credits are acquired by examining the 7^{th} level learning outcomes of compulsory and elective courses in line with the Ordinance, and180 ECTS credits in the activities related to the original scientific research resulting in writing and defending of the doctoral thesis.

The student achieves the minimum of 42 ECTS upon the examination of the learning outcomes of this study programme, and the remaining credits (maximum of 18 ECTS credits) can be achieved through acquisition and examination of 7^{th} level learning outcomes at the constituent entities of the University of Split, other universities in the Republic of Croatia and/or abroad. According to the Ordinance, upon supervisor`s request, a certain number of ECTS credits can be awarded to the student for previously acquired 7^{th} level learning outcomes. Ideally, the candidate can be released from attending classes at the preparatory year.

The Faculty of Civil Engineering, Architecture and Geodesy provides professional scientific advancement to doctoral candidates in the area of technical sciences, filed of Civil Engineering and other fundamental technical sciences.

Upon the completed admission procedure, a supervisor is assigned to each student. Co-supervisor can be appointed in addition to the supervisor. Supervision is granted pursuant to Article 33 of the Ordinance. In order to obtain the doctoral the degree, the candidate, under the supervisor`s supervision, performs research-related activities, which are provided by the study programme through Research I, II and III. The student thus acquires knowledge and skills for independent research and successful preparation of his/her dissertation.

1.2. List of compulsory and elective courses

Except for Research I, II and III and the course Methodology and Techniques of Scientific Research, all other courses are elective. Depending on the candidate`s interest and research topic, the supervisor advises the candidates on the selection of courses, whereas the selected courses should be applicable to the research topic. Each course is represented through the immediate classes and the writing of the seminar paper, which contains experimental work and theoretic analysis of the concerned issue. The seminar paper is composed in line with the rules set out for

the writing of scientific and professional papers. The majority of exams are carried out through oral presentation of the seminar paper, unless otherwise provided by the syllabus.

Research-relate activities carried out for the purpose of obtaining the doctoral degree are provided in the study programme through the courses Research I, II and III, which prepare the student for successful participation and autonomy in research-related activities and the composition of the dissertation. Learning outcomes are examined through seminar papers presenting research methods and papers accepted for publishing in journals or papers accepted for presentation at international conferences.

The list of compulsory (research) activities and elective courses across semesters with the number of ECTS credits is presented in the following tables:

I semester		
Code	**Course title / activities**	**ECTS**
GATA01	Methodology and Techniques of Scientific Research	6
	Elective courses	24
TOTAL:		**30**

II semester		
Code	**Course title / activities**	**ECTS**
	Elective courses	30
TOTAL:		**30**

III semester		
Code	**Course title / activities**	**ECTS**
GAXA01	Research I	30
TOTAL:		**30**

IV semester		
Code	**Course title / activities**	**ECTS**
GAXA01	Research I	30
TOTAL:		**30**

V semester		
Code	**Course title / activities**	**ECTS**
GAXB01	Research II	30
TOTAL:		**30**

VI semester		
Code	**Course title / activities**	**ECTS**
GAXB01	Research II	30
TOTAL:		**30**

VII semester		
Code	**Course title / activities**	**ECTS**
GAXC01	Research III	30
TOTAL:		**30**

VIII semester		
Code	**Course title / activities**	**ECTS**
GAXC01	Research III	30
TOTAL:		**30**

The following is a list of activities and courses with ECTS credits and workload.

Table 1

CODE	COMPULSORY RESEARCH ACTIVITIES REQUIRED FOR THE DOCTORAL DEGREE IN THE FIELD OF CIVIL ENGINEERING	ECTS credits
GAXA01	Research I	60
GAXB01	Research II	60
GAXC01	Research III	60

Table 2

CODE	COMPULSORY COURSE IN THE AREA OF TECHNICAL SCIENCES	weekly workload	ECTS credits
GATA01	Methodology and Techniques of Scientific Research	30+0	6

Table 3

CODE	ELECTIVE COURSES IN THE FIELD OF CIVIL ENGINEERING, BRANCH OF BEARING STRUCTURES	weekly workload	ECTS credits
GAKA01	Meshless Numerical Methods and Corresponding Adaptive Techniques	30+0	6
GAKA02	Numerical Modelling of Shell Structures	30+0	6
GAKA03	Numerical Methods for the Mechanics of Materials	30+0	6
GAKA04	Experimental Methods	30+0	6
GAKA05	Selected chapters of Structural Dynamics and Earthquake Engineering	30+0	6
GAKA06	Selected chapters of Stability of structures	30+0	6
GAKA07	Finite Element Method	30+0	6
GAKA08	Extreme Actions and Structure Safety/Stability	30+0	6
GAKA09	Steel and Composite Structures	30+0	6
GAKA10	Numerical Modelling of Concrete Structures	30+0	6
GAKA11	Design of Supporting Systems of Bridges and Structures	30+0	6
GAKA12	Mechanics of Discontinua	30+0	6
GAKA13	Numerical Modelling of Water-Soil-Structure Dynamic Interaction	30+0	6
GAKA14	Advanced Concrete and Masonry Structures	30+0	6

Table 4

CODE	ELECTIVE COURSES IN THE FIELD OF CIVIL ENGINEERING, BRANCH OF HYDROTECHNICS	weekly workload	ECTS credits
GAHA01	Dispersion Processes in Water Resources	30+0	6
GAHA02	Theory of Risk Assessment in Environmental Engineering	30+0	6
GAHA03	Karst Water Resources	30+0	6
GAHA04	Ecohydrology	30+0	6
GAHA05	Hydrological Modelling in Karst	30+0	6
GAHA06	Marine Hydraulics, special chapters	30+0	6
GAHA07	System Engineering in Water Resources Management	30+0	6
GAHA08	Sustainable Urban Water Systems	30+0	6
GAHA09	Selected chapters on Karst Hydrogeology	30+0	6
GAHA10	Introduction to Engineering Numerical Modelling	30+0	6
GAHA11	Analysis of Hydrological Time Series	30+0	6

Table 5

CODE	ELECTIVE COURSES IN THE FIELD OF CIVIL ENGINEERING, BRANCH OF TRANSPORTATION	weekly workload	ECTS credits
GAPA01	Traffic Flow Theory	30+0	6
GAPA02	Highways – selected chapters	30+0	6
GAPA03	Transport Planning	30+0	6

Table 6

CODE	ELECTIVE COURSES IN THE FIELD OF CIVIL ENGINEERING, BRANCH OF GEOTECHNICS	weekly workload	ECTS credits
GAGA01	Selected chapters from Rock Mechanics	30+0	6
GAGA02	Soil Mechanics Models	30+0	6
GAGA03	Special chapters in Foundation Engineering	30+0	6

Table 7

CODE	ELECTIVE COURSES IN THE FIELD OF CIVIL ENGINEERING, BRANCH OF MATERIALS	weekly workload	ECTS credits
GAMT01	Rheology of Materials	30+0	6
GAMT02	New Materials in Civil Engineering	30+0	6

Table 8

CODE	ELECTIVE COURSES IN THE FIELD OF OTHER FUNDAMENTAL TECHNICAL SCIENCES, BRANCH OF ORGANISATION OF WORK AND PRODUCTION	weekly workload	ECTS credits
GALA01	System Engineering in Project Management	30+0	6
GALA02	Decision Support Systems	30+0	6
GALA03	System Theory	30 + 0	6

Table 9

CODE	ELECTIVE COURSE IN THE FIELD OF ARCHITECTURE AND URBAN PLANNING	weekly workload	ECTS credits
GAAA01	Highways and the Environment	30+0	6

Table 10

CODE	ELECTIVE COURSES IN THE AREA OF TECHNICAL SCIENCES	weekly workload	ECTS credits
GATA02	Information Engineering	30+0	6
GATA03	Engineering Simulations Techniques	30+0	6

Table 11

CODE	ELECTIVE COURSES IN THE FIELD OF NATURAL SCIENCES, BRANCH OF MATHEMATICS	weekly workload	ECTS credits
GAMA01	Applied Functional Analysis	30+0	6
GAMA02	Practical Methods of Optimisation	30+0	6
GAMA03	Mathematical Analysis of Boundary-value Problems	30+0	6
GAMA04	Integral Equations	30+0	6
GAMA05	Methods of Mathematical Statistics	30+0	6

Course title	METHODOLOGY AND TECHNIQUES OF SCIENTIFIC RESEARCH
Code	GATA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher and the Committee for Postgraduate Studies. Teaching (30 hours) = 1.6 ECTS Independent work and studying (36 hours) = 2.4 ECTS Writing of research seminar paper (20 hours) = 2.0 ECTS;
Teachers and/or associates	Prof. Pavao Marović, PhD / Prof. Mirela Galić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • differentiate between written papers and their categorisation, • classify scientific and artistic papers by scientific fields and branches, • differentiate between scientific and scientific-research titles, • learn the signs for correcting text errors, • write and format the scientific and professional paper, • properly cite the used literature, • correct the text of the scientific and professional paper, • decide on the categorisation of certain scientific or professional paper, • self-evaluate and review scientific and professional paper.
Recommended literature	(1) Zelenika, R.: *Metodologija i tehnologija izrade znanstvenog i stručnog djela*. Ekonomski fakultet, 781 str., Rijeka, 2000. (2) Simonić, A.: *Znanost: najveća avantura i izazov ljudskog roda*. Sveučilište u Rijeci, 483 str., Rijeka, 1999.
Supplementary literature	(1) Zelenika, R.: *Znanost o znanosti*. 5. izmij. i dop. izd., Ekonomski fakultet, XXIII + 422 str., Rijeka, 2004. (2) Silobrčić, V.: *Kako sastaviti, objaviti i ocijeniti znanstveno djelo*. 5. dop. izd., Medicinska knjiga, VIII + 220 str, Zagreb, 2003. (3) Tkalec Verčić, A.; Sinčić Ćorić, D.; Pološki Vokić, N.: *Priručnik za metodologiju istraživačkog rada: Kako osmisliti, provesti i opisati znanstveno i stručno istraživanje*. M.E.P. d.o.o., Zagreb, 2010. (4) Tuđman, M.: *Obavijest i znanje*. Radovi Zavoda za informacijske studije, knjiga 2, 264 str., Zagreb, 1990.
Teaching methods	Lectures with PowerPoint presentations, Monitoring progress of writing of the seminar paper. Consultations.
Assessment methods	Oral presentation of the seminar paper. Oral exam.

Teaching units	**Duration**
Basic terminology regarding scientific and professional papers; classification of science (areas, fields, branches); research and scientific-teaching titles; writing and correcting of text; citing literature within the text and in bibliography; peer-review process. Application to competitive research projects. Patent and intellectual property protection.	30

Methodology and Technique of Scientific Research GATA01 6.0	Prof. Pavao Marović, PhD / Prof. Mirela Galić, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminar2** One seminar paper required. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	RESEARCH I
Code	GAXA01
ECTS (number of allocated credits)	60.0 Number of ECTS credits was calculated according to the assessment of the potential supervisor and the Committee for Postgraduate Studies. • Research-related activities (1560 hours) = 52.0 ECTS; • and/or Submission of the research proposal (60 hours) = 2.0 ECTS; • and/or Participation in the organisation of a scientific conference (60 hours) = 2.0 ECTS • Writing, preparation and defence of the seminar paper (60 hours) = 2.0 ECTS; • Preparing public presentation of the research topic/doctoral thesis (60 hours) = 2.0 ECTS;
Teachers and/or associates	Supervisor(s) proposed by the Committee for Postgraduate University Study and approved by the Faculty Council.
Learning outcomes and competences	• Put forward a research hypothesis; • Prepare and present communication about research findings; • Successfully defend the hypothesis and research results and present substantiated arguments; • Participate with the members of the team within scientific-research activities.
Recommended literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Supplementary literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Teaching methods	Consultations and monitoring of progress of writing of seminar papers and papers for publishing. Permanent consultations.
Assessment methods	Publicly presented seminar paper which shows research results and/or overview of the selected area of research. The paper has to be in the form of a scientific paper. Additionally, research outcomes can be tested through scientific papers sent to journals or accepted for presentation at conferences.

Teaching units	**Duration**
Independent research and experimental work under the supervisor`s supervision within the research project and the topic of the doctoral thesis. Individual writing of scientific papers with the supervisor. Details are defined by the supervisor depending on the topic of research/doctoral thesis.	

Course title	RESEARCH II
Code	GAXB01
ECTS (number of allocated credits)	60.0 Number of ECTS credits was calculated according to the assessment of the potential supervisor and the Committee for Postgraduate Studies. • Research-related activities (1260 hours) = 42.0 ECTS; • and/or Submission of the research proposal (60 hours) = 2.0 ECTS; • and/or Participation in the organisation of a scientific conference (60 hours) = 2.0 ECTS • Writing, preparation and defence of the seminar paper (60 hours) = 2.0 ECTS; • Preparing public presentation of the research topic/doctoral thesis (60 hours) = 2.0 ECTS; • Preparing and writing a paper for an international scientific conference and/or international peer-reviewed journal (300 hours) = 10.0 ECTS
Teachers and/or associates	Supervisor(s) proposed by the Committee for Postgraduate University Study and approved by the Faculty Council.
Learning outcomes and competences	• Put forward a research hypothesis; • Prepare and present communication about research findings; • Successfully defend the hypothesis and research results and present substantiated arguments; • Participate with the members of the team within scientific-research activities.
Recommended literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Supplementary literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Teaching methods	Consultations and monitoring of progress of writing of seminar papers and papers for publishing. Permanent consultations.
Assessment methods	Seminar paper which shows research results and/or overview of the selected area of research. The paper has to be in the form of a scientific paper. Accepted and/or published paper at an international scientific conference and/or international peer-reviewed journal.

Teaching units	**Duration**
Independent research and experimental work under the supervisor`s supervision within the research project and the topic of the doctoral thesis. Individual writing of scientific papers with the supervisor. Details are defined by the supervisor depending on the topic of research/doctoral thesis.	

Course title	RESEARCH III
Code	GAXC01
ECTS (number of allocated credits)	60.0 Number of ECTS credits was calculated according to the assessment of the potential supervisor and the Committee for Postgraduate Studies. · Research-related activities (630 hours) = 21.0 ECTS; · and/or Submission of the research proposal (60 hours) = 2.0 ECTS; · and/or Participation in the organisation of a scientific conference (60 hours) = 2.0 ECTS · Writing, preparation and defence of the seminar paper (60 hours) = 2.0 ECTS; · Preparing public presentation of the research topic/doctoral thesis (600 hours) = 20.0 ECTS; · Preparing and/or writing a paper for an international peer-reviewed journal (450 hours) = 15.0 ECTS
Teachers and/or associates	Supervisor(s) proposed by the Committee for Postgraduate University Study and approved by the Faculty Council.
Learning outcomes and competences	• Write and successfully publish at least one scientific paper as the main author in an international peer-reviewed journal ; • Prepare and present a public communication about the research results at an international conference ; • Successfully defend the hypothesis and the results of scientific research, and present substantiated arguments in the discussion at the international conference; • Provide critical analysis and assessment of published scientific papers of other authors within the selected scientific area.
Enrolment requirements	Research I and II and 60 ECTS credits from the preparatory year.
Recommended literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Supplementary literature	Depending on the topic of the research/doctoral thesis in line with the supervisor`s guidelines.
Teaching methods	Consultations and monitoring of progress of writing of seminar papers and papers for publishing. Permanent consultations.
Assessment methods	At least one paper accepted and/or published in an international peer-review journal cited in CC or Web of Science, and at least one paper presented at an international conference. Accepted and defended doctoral thesis.

Teaching units	**Duration**
Independent research and experimental work under the supervisor`s supervision within the research project and the topic of the doctoral thesis. Individual writing of scientific papers with the supervisor. Details are defined by the supervisor depending on the topic of research/doctoral thesis.	

Course title	MESHLESS NUMERICAL METHODS AND CORRESPONDING ADAPTIVE TECHNIQUES
Code	GAKA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Blaž Gotovac, PhD / Prof. Vedrana Kozulić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • Classify the types of known meshless numerical methods • Analyse geometry of the concerned area and boundary conditions by meshless method of R functions • Conduct analysis of engineering problems described by ordinary and partial differential equations by meshless methods • Analyse engineering problems by applying adaptive collocation method • Analyse stability and accuracy of adaptive meshless techniques
Recommended literature	(1) Atluri, S.N., ″Methods of Computer Modeling in Engineering & the Sciences″, Volume I, Tech Science Press, University of California, Irvine, 2005. (2) Griebel, M. and Schweitzer, M.A. (Eds.), ″Meshfree Methods for Partial Differential Equations″, Springer-Verlag, Berlin, 2003. (3) Liu, G.R., ″Mesh free methods: Moving beyond the Finite Element Method″, CRC Press LLC, Boca Raton, 2003.
Supplementary literature	(1) Gotovac B., Numeričko modeliranje inženjerskih problema pomoću glatkih finitnih funkcija, Disertacija, Fakultet građevinskih znanosti Sveučilišta u Zagrebu, Zagreb, 1986. (2) Kozulić V., Numeričko modeliranje metodom fragmenata pomoću Rbf funkcija, Disertacija, Građevinski fakultet, Sveučilište u Splitu, 1999. (3) Gotovac H., Tečenje i pronos s promjenjivom gustoćom u vodonosnicima, Magistarski rad, Građevinsko-arhitektonski fakultet, Sveučilište u Splitu, 2005. (4) Prenter P. M., Splines and Variational Methods, John Wiley & Sons, Inc., New York, 1989. (5) Rvačev V. L., Teorija R-funkcij i nekotorija jeje priloženija, Naukova dumka, Kiev, 1982. (6) Čolak I., Numeričko modeliranje savijanja tankih ploča općeg oblika, Disertacija, Građevinski fakultet, Sveučilište u Mostaru, 2002. (7) Cruz, P., Mendes, A., Magalhes, F.D., Using wavelets for solving PDEs: and adaptive collocation method, Chemical Eng. Science, 56, 3305-3309, 2001.
Teaching methods	Lectures with the use of computers, consultation, seminar paper.
Assessment methods	Presentation of seminar paper results.

Teaching units	**Duration**
Review of classical numerical methods from the aspect of selection of solutions` base functions.	6
Finite base functions from universal vector space from the aspect of practical use.	6
Influence of the geometry of the area on the required problem solution - idea of R-functions method.	6
Overview of adaptive techniques with the emphasis on the point collocation method and establishing numerical solutions with pre-set accuracy.	4
Non-linear and non-stationary analysis of structures by using adaptive technique.	4
Illustration of application of the adaptive procedure on simple examples, and the comparison of gained results with conventional solutions.	4
Composition of research seminar paper.	60

Meshless Numerical Methods and Corresponding Adaptive Techniques GAKA01 6.0	B. Gotovac V. Kozulić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of seminar paper. Oral exam. **Terms** By agreement.

Course title	NUMERICAL MODELLING OF SHELL STRUCTURES
Code	GAKA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Vedrana Kozulić, PhD / Prof. Blaž Gotovac, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • Independently create a numerical model of a building structure built of planar elements. • Properly describe arbitrary load, characteristics of material, boundary conditions at the border of a general form • Provide critical analysis of gained results in order to deliver proper engineering solutions.
Recommended literature	(1) Bathe, K. J., Finite Element Procedures in Engineering Analysis, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1982. (2) Zienkiewicz O.C., Taylor R.L., The Finite Element Method, Vol. 2: Solid Mechanics, Fifth edition, Butterworth-Heinemann, Oxford, 2000. (3) Irons B., Ahmad S., Techniques of Finite Elements, Ellis Horwood Limited, Chichester, 1980.
Supplementary literature	(1) Gotovac B., Kozulić V., Čolak I.: Uvod u numeričko modeliranje prostornih konstrukcija, Sveučilište u Mostaru, Mostar, 2001. (2) Hou-Cheng Huang: Static and Dynamic Analysis of Plates and Shells: Theory, Software and Applications, Springer-Verlag, London, 1989. (3) Figueiras J.A. and Owen D.R.J.: Analysis of elasto-plastic and geometrically nonlinear anisotropic plates and shells, In: Finite element software for plates and shells, eds. E. Hinton, D. R. J. Owen, Swansea, pp. 235-322, 1984. (4) Hinton E. and Abdel Rahman H.H.: Mindlin plate finite elements, In: Finite element software for plates and shells, eds. E. Hinton, D. R. J. Owen, Swansea, pp. 157-229, 1984.
Teaching methods	Lectures, seminar paper. Illustration of part of learnt material in practical tasks.
Assessment methods	Oral presentation of the seminar paper. Oral exam.

Teaching units	**Duration**
Plane stress and bending of thin plates as special cases of shell structure models.	6
Membrane and shear locking and its illustration on the line curved girder.	2
Relationship between axe symmetric problems and special types of rotational shell structures.	4
Examples of shell structures with geometry described by elementary functions as plane, sphere, cylinder, cone, hyper etc.	4
Shells with regular geometry in one direction. Review of the classical theory of shells.	4
Shell structures of general shape (analysis by 8.-node finite elements developed from 20.-node space isoparametric finite element).	4
Computer programs: numerical simulation of mentioned phenomena and critical analysis of obtained results.	6
Composition of research seminar paper.	60

Numerical Modelling of Shell Structures GAKA02 6.0	V. Kozulić B. Gotovac	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	NUMERICAL METHODS FOR THE MECHANICS OF MATERIALS
Code	GAKA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Pavao Marović, PhD / Prof. Mirela Galić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • formulate concepts and actual achievements in the area of the mechanics of materials, • select relevant numerical method at problem-solving in the area of the mechanics of materials, • create parts of computer software related to the mechanics of materials and calculations by the finite element method, • evaluate the results of numerical calculations in the area of the mechanics of materials, • suggest an appropriate numerical model depending on the type of material.
Recommended literature	(1) I. Alfirević: *Uvod u tenzore i mehaniku kontinuuma*, Golden marketing, Zagreb, 2003.; (2) S.P. Timoshenko: *Mechanics of Materials*, Van Nostrand Reinhold Co., New York, 1972. (3) A. Mihanović, P. Marović, J. Dvornik: *Nelinearni proračuni armirano betonskih konstrukcija*, DHGK, Zagreb, 1993.; (4) D.R.J. Owen, E. Hinton: *Finite Elements in Plasticity: Theory and Applications*, Pineridge Press, Swansea, 1980.
Supplementary literature	(1) J. Bonet, R.D. Wood: *Nonlinear Continuum Mechanics for Finite Element Analysis*, Cambridge University Press, 1977.; (2) G.A. Holzapfel: *Nonlinear Solid Mechanics – A Continuum Approach for Engineering*, Wiley, Chichester, 2000.
Teaching methods	Lectures with PowerPoint presentations. Composition of individual studies with the supervisor's assistance and independently during the semester where the students apply the acquired knowledge and learn basic numerical procedures in the process of numerical modelling of the model in the area of the mechanics of material. Independent design of parts of computer software.
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
Parameters of the solid state body: strength, elasticity, viscosity, visco-elasticity, plasticity, thermoelasticity. Load, time, temperature. Mechanical properties of materials under impact and cyclic load. Strength of materials under complex stress. Static and dynamic load. Overview and introduction into different numerical methods for numerical approximation of the description of behaviour of different materials: orthotropic and anisotropic materials, concrete (macro and micro models), stone, steel, soil, elastomers (plastics, rubber), timber. Classical elasto-plastic and elasto-visco-plastic numerical models. Geometrical non-linearity of structures – finite deformations. Geometrical non-linearity of structures – large displacements. Total and update Lagrange method. Numerical modelling of time-dependent influences: creep, cyclic actions, dynamical actions. Numerical models of composite materials. Procedures for solving systems of non-linear algebraic equations: Newton-Raphson method, Modified Newton-Raphson method, quasi-Newton method, Arc-length method.	30

Numerical Methods for the Mechanics of Materials GAKA03 6.0	P. Marović M. Galić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	EXPERIMENTAL METHODS
Code	GAKA04
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Pavao Marović, PhD / Prof. Mirela Galić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • devise an appropriate programme of testing structures, structural elements or structure models, • independently conduct experimental testing of the structure, structural element or structure model, • interpret testing results, • evaluate possible problem solutions, • critically analyse the rule of modelling and measurement, • discuss the selected model fro experimental analysis of the structure, structural element or structure model.
Recommended literature	(1) *Mjerenje deformacija i analiza naprezanja*, Autorizirana Lectures, Ur. A. Kiričenko, DGITZ, Zagreb, 1982.; (2) I. Alfirević, S. Jecić: *Fotoelasticimetrija*, Liber, Zagreb, 1983.
Supplementary literature	(1) J.F. Doyle: *Modern Experimental Stress Analysis*, Wiley, Chichester, 2004.
Teaching methods	Lectures with PowerPoint presentations. Demonstration exercises in the laboratory. Organising and conducting testing of structure, structural elements and structure models, where the students implement gained knowledge.
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
The importance of experimental analyses for the development of structures and calculation methods. Development of experimental methods assisted with micro-computers, micro-processors, automatics and telemetry – static and dynamic testing. Mechanical properties of materials. Strain and stress theory equations and the solid state body laws. Measurements, measurement techniques, metrology, measurement equipment and analysis of measurements. Model analysis of structures. Conditions of similarity. Modelling rules. Buckingham theorem. Materials for models. Procedures for determining deformation fields, strain fields, angles of rotation, deflections and curvatures. Implementation domain and accuracy of different measuring methods. Optic stress and optic strain methods for determining stress and strain fields. Plane photoelasticity. Space photoelasticity. Photo -plasticity, -viscoelasticity, -rheology. Dynamical photoelasticity. Methods of photoelastic coatings and brittle lacquers method. Moire method. Methods of analogy. Mathematical analogy. Electrical analogy (current and voltage). Implementation of mechanical waves, g- and x- rays in the stress state analysis.	30

Experimental Methods GAKA04 6.0	P. Marović M. Galić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	SELECTED CHAPTERS OF STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING
Code	GAKA05
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ante Mihanović, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • Create non-linear deterministic models of structures dynamic • Analyse earthquake resistance of structures by launching principle • Formulate models of direct response of structures to earthquake stimulation Formulate stochastic models of structures dynamics • Model the interaction structure-soil in dynamic tasks
Recommended literature	(1) Humar J.L., Dynamic of structures, Prentice Hall, New Jersey, 1990. (2) Mihanović A., Dinamika konstrukcija, Građevinski fakultet Split, Split, 1995. (3) Čaušević M, Dinamika konstrukcija, Mladost Zagreb 2005.
Supplementary literature	(1) A.K. Chopra: Dynamic of structures – Theory and Applications to Earthquake Engineering, Prentice Hall, New Jersey, 1995. (2) Morrison F., The art of modelling dynamic system: forecasting for chaos, randomness, and determinism (Scientific and Technical Computation Series), Ronald Press, 1991.
Teaching methods	Lecture, seminars.
Assessment methods	Oral presentation of the seminar paper. Oral exam.

Teaching units	**Duration**
Response of single-degree-of-freedom system and multiple-degree-of-freedom system by direct numerical integration. Spectral radius and numerical stability. Mixed methods. Material non-linear systems. Accuracy..	4
Dynamics simulation of infinite boundary. Numerical integration in structure-fluid interaction and structure-fluid-soil interaction.	2
Numerical integration of complex civil engineering structures response.	8
Fast Fourier transforms. Windous and wavelet procedures in structural dynamics. Structure response to random excitation by earthquake, wind, waves and sea-streams.	2
Structure reliability in earthquake activities.	10
Stationary and non-stationary models. Resonance response spectra.	2
Composition of research seminar paper.	60

Selected chapters of Structural Dynamics and Earthquake Engineering GAKA05 6.0	A. Mihanović A. Mihanović	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	SELECTED CHAPTERS OF STABILITY OF STRUCTURES
Code	GAKA06
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ante Mihanović, PhD; Associate Prof. Boris Trogrlić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • Create numerical models of material and geometrically non-linear load capacity and stability of spatial linear structures • Model the problems of bending, shear and torsion stability on spatial framework structures • Model numerically the load capacity and stability of plates and shells by the theory of small and large displacements • Analyse spectra of load capacity of pressure bending elements and apply quasi non-linear procedures
Recommended literature	(1) Bažant Z.P. and Cedolin L., Stability of structures: Elastic, Inelastic, Fracture and Damage Theories, Dover Publications, Inc., New York, 2003. (2) Mihanović A., Stabilnost konstrukcija, DHGK, Zagreb, 1993.
Supplementary literature	(1) Trogrlić B., Nelinearni numerički model stabilnosti i nosivosti prostornih armirano-betonskih linijskih konstrukcija, doktorska disertacija, Građevinsko-arhitektonski fakultet, Sveučilište u Splitu, Split, 2003. (2) Jurić A., Nelinearni numerički model stabilnosti i nosivosti prostornih čeličnih linijskih konstrukcija, doktorska disertacija, Građevinsko-arhitektonski fakultet, Sveučilište u Splitu, Split, 2004.

Teaching units	**Duration**
The materially and geometrically non-linear numerical model of stability and load capacity of the space line structures using small displacement theory. Implementation of bending, shear and torsion stability. Numerical modelling of stability and load-bearing capacity for plate and shell structures using small and large displacement theory.	6
Modelling of local stability of thin-wall cross sections.	2
Stability and load capacity of the space line structures using large displacement theory.	4
Accuracy estimation of the solution.	2
Modelling of gravity, polar and hydrostatic load. Particularity of non-linear structures and modelling of cable structures. Particularity of numerical modelling of arch structures stability.	4
Determination of pressure bending elements bearing spectrum and application of quasi-nonlinear procedures.	4
Numerical modelling of stability and load-bearing capacity for plate and shell structures using small and large displacement theory.	6
Post-critical behaviour of plate and shell structures.	2
Composition of research seminar paper.	60

Selected Chapters of Stability of structures GAKA06 6.0	A. Mihanović B. Trogrlić A. Mihanović B. Trogrlić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	FINITE ELEMENT METHOD
Code	GAKA07
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Željana Nikolić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • develop mathematical and numerical formulations for the purpose of numerical solving of different engineering tasks by finite element method; • independently create computer software using finite element method; • independently evaluate the accuracy of numerical models; • critically review the applicability of the used numerical model in the analysis of the presented task, • between several variants of solutions, select and recommend the appropriate numerical formulation and model for the solution of the given problem and provide arguments for his/her position.
Recommended literature	1) O. C. Zienkiewicz, R. L. Taylor, J.Z. Zhu: The Finite Element Method, Vol. 1: Its Basis & Fundamentals, 6th edition, Elsevier Butterworth-Heinemann, Oxford, 2006.; (2) A. Ibrahimbegovic: Nonlinear Solid Mechanics: Theoretical Formulations and Finite Element Solution Methods, Springer, 2009.; (3) V. Jović: Uvod u inženjersko numeričko modeliranje, Aquarius engineering Split, 1993.; (4) R. D. Cook, D. S. Malkus, M. E. Plesha: Concepts and Applications of Finite Element Analysis, 3th edition, John Wiley & Sons, 1989.
Supplementary literature	(1) M. A. Crisfield: Finite Elements and Solution Procedures for Structural Analysis, Vol I: Linear Analysis, Pineridge Press, Swansea, U.K., 1986.; (2) O. C. Zienkiewicz, K. Morgan: Finite Elements and Approximations, John Wiley & Sons, 1983.; (3) E. Hinton, D. R. J. Owen: An Introduction to Finite Element Computations, Pineridge Press, Swansea, U.K., 1979.; (4) J. Sorić: Metoda konačnih elemenata, Golden marketing – Tehnička knjiga Zagreb, 2004.; J. Brnić, M. Čanađija: Analiza deformabilnih tijela metodom konačnih elemenata: Fintrade & Tours d.o.o. Rijeka, 2009.
Teaching methods	Lectures with computers. Preparation of individual studies with the assistant of the supervisor and independently, where the students implement gained knowledge and learn basic numerical procedures in the finite element method analysis. Independent design of parts of computer software.
Assessment methods	Oral presentation of the seminar paper, Oral exam.

Teaching units	**Duration**
System discretisation. Direct approach to solving structural mechanics problems. Generalisation of the finite element concepts.	2
Variation formulation of finite element method.	1
Finite elements for one-dimensional analysis.	1
Finite elements for two-dimensional and axe symmetric analysis.	3
Finite elements for three-dimensional analysis.	2
Standard and hierarchical base functions.	1
Finite element mapping and numerical integration.	2

Pach test, reduced integration and non-conforming elements. Infinite elements.	2
Mixed formulations.	2
Error estimates and convergence of numerical procedures.	1
Adaptive techniques: h, p, hp approach.	2
Finite element method in time dependent problems.	2
Coupled problems: fluid-structure and soil-structure interaction.	2
Basis numerical procedures for finite element analysis.	2
Finite element method with installed discontinuities (ED-FEM) and expanded finite element method (X-FEM) in modelling structural singularities.	5

Finite element method GAKA07 6.0	Ž. Nikolić	**Lectures** • 30 hours • Use of blackboard, PP presentation and computer classrooms Literature, consultations and exam can be carried out in English	**Seminars** Orally presented seminar paper. Seminar paper is 50% of the total grade. **Exam requirements** Submitted and defended seminar paper. **Exam** Only oral exam, which is 50% of the total grade. **Terms** By agreement.

Course title	EXTREME ACTIONS AND STRUCTURE SAFETY/STABILITY
Code	GAKA08
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Bernardin Peroš, PhD / Prof. Ivica Boko, PhD / Assistant Professor Neno Torić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • anticipate the statistical model of extreme actions, • compare first and second-order reliability methods, • assess structural reliability index during extreme actions, • evaluate the probability analysis for the calibration of existing structures, • determine the level of structural safety from the aspect of durability of structures, • anticipate and self-evaluate the analysis of structure life.
Recommended literature	(1) Milčić V., Peroš B.: Uvod u teoriju sigurnosti nosivih konstrukcija, Građevinski fakultet Split, 2003.; (2) Peroš B., Boko I.: Sigurnost konstrukcija u požaru, Sveučilište u Splitu Fakultet građevinarstva, arhitekture i geodezije, Split, 2014.; (3) Sheldon M. Ross: Introduction to probability and statistics for engineers and scientists, University of California at Berkeley, 1997.
Supplementary literature	(1) Schueler, Shinozuka: Structural Safety and Reliability, Proc. Icossar, Vol 1,2,3, Innsbruck, 1993.; (2) Kiureghain L.:Structural component Reliability and Finite element, Reliability Methods, Lecture Note for "Structural Reliability - Methods and Applications", University of California at Berkeley, 1989.; (3) Structural reliability analysis program system (STRUREL).
Teaching methods	Lectures with the use of the blackboard, slides and LCD projector. Parts of lectures are based on the European Steel Design Education Programme (ESDEP).
Assessment methods	Oral exam, seminar paper.

Teaching units	**Duration**
Relevance of the course. Main concepts on the reliability and stability of structures. Base variables of actions on structure and structural resilience. Probability of failure of load capacity, reliability index. Analysis of extreme actions on the structures – application of modern methods for finding the optimal functions for the distribution of specific actions. Probability models for the structure response in cases of extreme actions. Reliability model for random variables, random process and random field/domain. The calibration procedure for complex structures considering reliability during the structure exploitation. Non-linear methods in the computational procedure for structure reliability – interaction between the stochastic and mechanic models. Analysis of the safety/stability degree of complex structures of the offshore type, bridges, etc. by applying the aforementioned models.	30

Extreme Actions and Structure Safety/Stability GAKA08 6.0	Prof. Bernardin Peroš, PhD, Prof. Ivica Boko, PhD, Assistant Professor Neno Torić, PhD	**Lectures** • 30 hours of lectures with the use of blackboard, slides and LCD projector Literature, consultations and exam can be carried out in English.	**Seminars** Orally presented seminar paper. **Exam** Oral exam. **Terms** By agreement.

Course title	STEEL AND COMPOSITE STRUCTURES
Code	GAKA09
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Bernardin Peroš, PhD / Prof. Ivica Boko, PhD / Assistant Professor Neno Torić, PhD
Learning outcomes and competences	Upon the completed course, the student will be able to: • determine the load capacity of steel and composite elements and systems by the first and second-order theory, • evaluate the joint calculation methods, • assess the load capacity of steel, composite elements and systems in the event of fire, • assess the load capacity of steel, composite elements and systems from the aspect of material wear.
Recommended literature	(1) Androić B., Dujmović D., Džeba I.: Čelične konstrukcije 1, IA projektiranje, Zagreb, 2009.; (2) Androić B., Dujmović D., Lukačević I.: Projektiranje spregnutih konstrukcija prema Eurocode 4, IA projektiranje, Zagreb, 2012.; (3) Androić B., Čaušević M., Dujmović D., Džeba I., Markulak D., Peroš B.: Čelični i spregnuti mostovi, IA projektiranje, Zagreb, 2005.; (4) R. Englekirk: Steel structures, John Wiley & Sons, Inc., New York, 1994.; (5) Peroš B., Boko I.: Sigurnost konstrukcija u požaru, Sveučilište u Splitu Fakultet građevinarstva, arhitekture i geodezije, Split, 2014.
Supplementary literature	(1) Knowles, P.R.: Composite Steel and Concrete Construction, Butterworks, London, 1973.; (2) Johnson, R. P. and Buckly, R. P.: Composite structures of Steel and Concrete, Volume 2, Bridges, Second Edition, 1986.
Teaching methods	Lectures with the use of the blackboard, slides and LCD projector. Parts of lectures are based on the European Steel Design Education Programme (ESDEP).
Assessment methods	Oral exam, seminar paper.

Teaching units	**Duration**
Elastic and plastic analysis in the computation of steel and composite structures. Frame systems – classification of global imperfection, length of element torsion, joints. Application of elastic and plastic methods in the computation of frame systems. Full-side tin supporter – problem of slab/plates stability. Composite structures of the steel – concrete type, analysis of elements in supporting systems. Problem of spatial steel systems and systems with tensile supporting structures. Application of high-quality steels for supporting steel systems and extreme spans (bridges, stadiums, halls, etc.).	30

Steel and Composite Structures GAKA09 6.0	Prof. Bernardin Peroš, PhD, Prof. Ivica Boko, PhD, Assistant Professor Neno Torić, PhD	**Lectures** • 30 hours of lectures with the use of blackboard, slides and LCD projector Literature, consultations and exam can be carried out in English.	**Seminars** Orally presented seminar paper. **Exam** Oral exam. **Terms** By agreement.

Course title	NUMERICAL MODELLING OF CONCRETE STRUCTURES
Code	GAKA10
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Radnić, PhD / Prof. Alen Harapin, PhD / Associate Professor Domagoj Matešan, PhD
Learning outcomes and competences	The student will be able to: • select the appropriate numerical model of behaviour of concrete and/or composite structures under static, dynamic and impact load, critical assessment of results and substantiate them with arguments; • select the appropriate numerical model for the description of geometrically and materially non-linear behaviour of concrete and/or composite structures and elaborate this selection; • create the model for dimensioning o composite cross sections, evaluation of model potentials and critical assessment of results; • select the model for the calculation of width of cracks and deflections/displacements of concrete elements, compare the results with other numerical models and experiments and perform critical selection of the most reliable model; • propose the proper model for the inclusion of rheological effects (creep/shrinkage/wear) into the numerical model for the description of behaviour of concrete elements and structures.
Recommended literature	(1) J. Radnić, A. Harapin,D. Matešan: „Betonske ploče i ljuske“, 2006. ; (2) J. Radnić, D. Ćubela, A. Harapin; „Modeliranje ravninskih spregnutih konstrukcija“, 2006. ; (3) J. Radnić, L. Markota, A. Harapin; „Raspucavanje betona – numeričko modeliranje“, 2005. ; (4) J.Radnić, A. Harapin, D. Brzović: „Modeliranje dinamičke interakcije tekućine i konstrukcije“ (pred dovršetkom) ; (5) J.Radnić: „Zapisi za Lectures“ (6) J. Radnić, A. Harapin: „Osnove betonskih konstrukcija“, course exam notes; (7) J. Radnić, A. Harapin: „Mostovi“, course exam notes
Supplementary literature	(1) J. Radnić, A. Harapin, D. Matešan: „Static Analysis of Concrete Shells“, Monograph, 2004. ; (2) Other literature by agreement.
Teaching methods	Lectures with the use of the blackboard, slides and LCD projector. Attending experimental testing of structures. Modelling behaviour of real structures with supervisor`s assistance and independently.
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
Behaviour and modelling of concrete under uniaxial and multiaxial states of stress.	5
Behaviour and modelling of steel under uniaxial and multiaxial states of stress.	1
Numerical modelling of concrete structures under static load.	6
Numerical modelling of concrete structures under dynamic load.	6
Numerical modelling of concrete structures under impact load.	2
Numerical modelling of composite structures.	2
Dimensioning of composite cross sections.	2
Modelling of width of cracks in concrete structures.	2
Modelling the dynamic interaction between concrete structures and fluids.	2
Some computational aspects of numerical analysis of individual and related fields/domains. Unsolved research problems	2
Composition of research seminar paper	60

Numerical Modelling of Concrete Structures GAKA10 6.0	J. Radnić A. Harapin D. Matešan J. Radnić A. Harapin D. Matešan	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam, Oral presentation of the seminar paper. **Terms** By agreement

Course title	DESIGN OF SUPPORTING SYSTEMS OF BRIDGES AND STRUCTURES
Code	GAKA11
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Radnić, PhD / Prof. Alen Harapin, PhD / Associate Professor Domagoj Matešan, PhD
Learning outcomes and competences	The student will be able to: • critically assess and evaluate the creation of simple and complex structural supporting bridge systems, • critically assess and evaluate the creation of complex structural supporting building systems, • critically assess and evaluate the creation of earthquake-resistant structural supporting systems, • critically assess and evaluate the creation of complex cable stay supporting systems
Recommended literature	(1) Androić Boris i suradnici: „Čelični i spregnuti mostovi“, 2006.; (2) M.J.Ryall, G.A.R. Parke i J.E.Harding: „Manual of bridge engineering“, 2002.; (3) D. Horvatić,Z. Šavor: „Metalni mostovi“, 1998.; (4) Jiri Strasky: „Stress ribbon and cable-supported pedestrian bridges“, 2005.; (5) Rene Walther at all: „Cable stayed bridges“, 1988; (6) C.Melbourne; „Arch bridges“, 1995; (7) J.Radnić: Zapisi za Lectures ; (8) J. Radnić, A. Harapin: „Osnove betonskih konstrukcija“, course exam notes; (9) J. Radnić, A. Harapin: „Mostovi“, course exam notes
Supplementary literature	(1) J. Radić: „Mostovi“, 2003.;(2) Other literature by agreement.
Teaching methods	Lectures with the use of the blackboard, slides and LCD projector
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
Materials and appropriate supporting structures	5
Main supporting systems for bridges	5
Bridges with complex structures	4
Supporting bridge systems with extreme spans	3
Main supporting building systems	5
Design of building structures with seismic resistance	4
New high-quality materials	2
Unsolved research problems	2
Composition of research seminar paper	60

Design of Supporting Systems of Bridges and Structures GAKA11 6.0	J. Radnić A. Harapin D. Matešan J. Radnić A. Harapin D. Matešan	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam, Oral presentation of the seminar paper. **Terms** By agreement

Course title	MECHANICS OF DISCONTINUA
Code	GAKA12
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ante Munjiza, PhD
Learning outcomes and competences	The student will be able to: • evaluate the effect of discontinua on a simulated problem • formulate the processes of discontinua • create problem simulations with pronounced discontinua effects • evaluate search methods and contact interactions in the processes of discontinua
Recommended literature	(1)A.Munjiza, The Combined Finite-Discrete Element Method, udžbenik, Wiley&Sons, London 2004., (2) A.Munjiza, Earl E. Knight, Esteban Rougier, Computational Mechanics of Discontinua , udžbenik, Wiley&Sons London 2011.,
Supplementary literature	Many papers in international journals at student`s selection.
Teaching methods	Lectures with the use of developmental programmes. Composition of independent seminar paper related to published scientific paper at student`s selection.
Assessment methods	Seminar paper and defence of seminar paper. Oral exam.

Teaching units	**Duration**
Introduction to discontinua: discontinuum at molecular level, nano-materials and mechanics of discontinua	6
Discontinuum processes	6
Discontinuum simulation	6
Numerical techniques	6
Application of techniques of discontinua mechanics	6
Composition of research seminar paper.	60

Mechanics of Discontinua GAKA12 6.0	A. Munjiza A. Munjiza	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	NUMERICAL MODELLING OF WATER-SOIL-STRUCTURE DYNAMIC INTERACTION
Code	GAKA13
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Radnić, PhD / Prof. Alen Harapin, PhD / Associate Professor Domagoj Matešan, PhD
Learning outcomes and competences	The student will be able to: • assess the need to use the model for modelling dynamic interaction between concrete structures and fluid in real structures; • proper/critical section of the numerical model for modelling dynamic interaction between concrete structures and fluids; • assess and evaluate gained results with several models, and the assessment of relevance of specific data; • prepare, conduct critical discussion and evaluation of the model of real structure by using the existing numerical model for the simulation of dynamic water-soil-structure interaction.
Recommended literature	(1) J. Radnić, A. Harapin, D. Brzović: knjiga „Modeliranje dinamičke interakcije tekućine i konstrukcije (pred dovršetkom). Odabrani članci iz područja numeričkog modeliranja dinamičkog međudjelovanja tekućina - tlo - konstrukcija.
Supplementary literature	(1) J. Radnić: „Modeliranje interakcije fluida i konstrukcije“, doktorska disertacija, 1987. ; (2) A. Harapin: „Numerička simulacija dinamičkog međudjelovanja tekućine i konstrukcije“, doktorska disertacija, 2000.
Teaching methods	Lectures with the use of blackboard, slides and LCD projector. Attending experimental dynamic testing of problems of single and coupled fields. Modelling of real problems of dynamic water-soil-structure interaction with the supervisor`s assistance and independently.
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
Methods for solving coupled fields problems	5
Simulation models of fluid – structures systems with linear material and geometrical models	7
Simulation models of fluid – structures systems with non-linear material and geometrical models	7
Some mathematical aspects of numerical analyses of single and coupled fields	5
Experimental research of coupled fields problems	3
Unsolved research problems.	2
Composition of research seminar paper	60

Numerical Modelling of Water-Soil-Structure Dynamic Interaction GAKA13 6.0	J. Radnić A. Harapin D. Matešan J. Radnić A. Harapin D. Matešan	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam, Oral presentation of the seminar paper. **Terms** By agreement

Course title	ADVANCED CONCRETE AND MASONRY STRUCTURES, SELECTED CHAPTERS
Code	GAKA14
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Radnić, PhD / Prof. Alen Harapin, PhD / Associate Professor Domagoj Matešan, PhD
Learning outcomes and competences	The student will be able to: • select the model for calculation and evaluation of results for complex strain states in simple and complex concrete elements/cross sections; • select the model for the analysis of cracks and deflections/displacements, and the calculation of width of cracks and deflections for simple and complex concrete elements, • create, critically discuss and evaluate the manner of installing reinforced concrete in complex concrete structures, • create, critically discuss and evaluate the selected solution of the complex rc/pre-stressed concrete element/structure; • create, critically discuss and evaluate the manner of installing reinforced concrete in complex concrete structures, • create, critically discuss and evaluate the manner of installing cables in complex pre-stressed structures, • select the constructive solution and selection/composition of the model and calculation of tall building, • select the constructive solution and selection/composition of the model and calculation of complex masonry structure.
Recommended literature	(1) I. Tomičić: „Betonske konstrukcije“, (2) J. Radić i suradnici: „ Betonske konstrukcije“, knjige 1,2,3; (3) J. Radnić, A. Harapin, D. Matešan: „Betonske ploče i ljuske“, (4) J. Radić i suradnici: „Zidane konstrukcije I“, (5) Z. Sorić: „Zidane konstrukcije 1“ ; (6) J. Radnić, A. Harapin: „Osnove betonskih konstrukcija“, course exam notes; (7) J. Radnić, A. Harapin: „Mostovi“, course exam notes
Supplementary literature	(1) J. Radnić, D. Ćubela, A. Harapin: „Modeliranje ravninskih spregnutih konstrukcija“, 2006.; (2) J. Radnić, L. Markota, A. Harapin: „ Raspucavanje betona – numeričko modeliranje“ 2005. ; (3) J. Radnić: „ Zapisi za Lectures“; (4) Other literature by agreement.
Teaching methods	Lectures with the use of blackboard, slides and LCD projector.
Assessment methods	Oral exam, oral presentation, seminar paper.

Teaching units	**Duration**
Basic behaviour of material, rheological effects of concrete	3
Calculation of crack width for complex concrete structures	3
Calculation of slender elements	2
Design and calculation of complex structures	5
Design of classical reinforced concrete	3
Design of cables	3
Design and calculation of seismic resistant structures	3
Design and calculation of complex masonry structures	3
Recovery of concrete and masonry structures	5
Composition of research seminar paper	60

Advanced Concrete and Masonry Structures, selected chapters GAKA14 6.0	J. Radnić A. Harapin D. Matešan J. Radnić A. Harapin D. Matešan	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam, Oral presentation of the seminar paper. **Terms** By agreement

Course title	DISPERSION PROCESSES IN WATER RESOURCES
Code	GAHA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Roko Andričević, PhD / Associate Professor Hrvoje Gotovac, PhD
Learning outcomes and competences	The student will be able to: • create a conceptual dispersion model in surface and underground waters considering the type of flow and transport • make and /or select the mathematical dispersion model in surface and underground waters considering the type of flow and transport • analyse practical dispersion problems, i.e. calculate and/or assess the field of concentration and time of travel using Eulerian method of finite volumes and elements • analyse practical dispersion problems, calculate and/or assess the field of concentration and time of travel using Lagrangian methods
Recommended literature	(1) Dagan. G, Flow and transport in porous formation, Springer-Verlag, 1989. (2) Andričević, R. Effects of local dispersion and sampling volume on the evolution of concentration fluctuations in aquifers, Water Resources Research,Water Resources Research, 34(5), pp. 1115-1129, 1998. (3) Andričević, R. and V. Cvetković, Relative dispersion for solute flux in aquifers, Journal of Fluid Mechanics, Vol. 361, pp. 145-174,1998. (4) Hassan, A.E., R. Andričević and V. Cvetković, Computational issues in the determination of solute discharge moments and implications for comparison to analytical solutions, Advances in Water Resources Journal, Vol. 24, pp. 607-619, 2001.
Supplementary literature	(1) Zhang, D., R. Andričević, A.Y. Sun, X. Hu and G. He, Solute flux approch to transport through spatially nonstationary flow in porous media, Water Resources Research, 36(8), pp. 2107-2120, 2000. (2) Purvance, D.T. and R Andričević, Geoelectric characterization of the hydraulic conductivity field and its spatial structure at variable scales**,** Water Resources Research, 36(10), pp. 2915-2924, 2000.
Teaching methods	Lectures with the use of developmental programmes. Composition of individual seminar paper as a reproduction of a published scientific paper.
Assessment methods	Seminar paper as a reproduction of the selected paper and final exam-written (done at home for 3-4 days).

Teaching units	**Duration**
Part one: review of main elements of stochastic processes, random domains and mathematical transformations in the Laplace and Fourier domains. Part two: Fundamental flow and dispersion equations. Transfer of the process to the local scale (scale of *in-situ* measurements). Heterogeneity of hydraulic conductivity and other parameters of the model. Part three: Eulerian and Lagrangian approaches to the solution of the dispersion equation. The concept of absolute and relative dispersion, the concept of mass discharge and dispersion of reactive substances. Flow and dispersion processes on the regional scale. The problem of averaging, effective parameter value, the concept of macro dispersion. Transport problems from point sources and non-point sources.	30

Dispersion Processes in Water Resources GAHA01 6.0	Prof. Roko Andričević, PhD / Associate Professor Hrvoje Gotovac, PhD	**Lectures** • 30 hours of lectures with the use of developmental programmes **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Written. **Terms** By agreement

Course title	THEORY OF RISK ASSESSMENT IN ENVIRONMENTAL ENGINEERING
Code	GAHA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Roko Andričević, PhD, Assistant Professor Veljko Srzić, PhD
Learning outcomes and competences	The student will be able to: • implement and/or select the risk concept in water resources • define and assess the risk of exposing people to cancerogenic and non-cancerogenic factors; • define and assess the risk of eco-system pollution • assess the risk of exposure within the risk analysis concept • apply the concept of risk analysis in managerial activities
Recommended literature	(1) Andričević, R. and V. Cvetković, Evaluation of risk from contaminants migrating by groundwater,Water Resources Research, 32 (3), 611-621, 1996. (2) Andričević, R., J. Daniels, and R. Jacobson, Radionuclide migration using travel time transport approach and its application in risk analysis, Journal of Hydrology, 163, 125-145, 1994. (3) Hamilton, L.D, R. Andričević, and R.L. Jacobson, Pilot study risk assessment for selected problems at three U.S. Department of Energy facilities, Environmental International, 20, 585-604, 1994. (4) U.S. EPA, 1988, Methods used in United States for the Assessment and Management of Health Risk Due to Chemicals, Federal Register PB89-222707, National Research Council, 1983, (5) Risk Assessment: Managing the process, National Academy Press, Washington, D.C.
Supplementary literature	(1) Fischoff, B., Lichtenstein, V., Slovic, V., Derby, S.L., Keeney, R.L.: Acceptable Risk, Cambridge University Press, New York, 1981. (2) Coastal and Estuarine Risk Assessment, edited by M. Newman, Lewis Publisher, 2002.
Teaching methods	Lectures with the use of developmental programmes. Composition of individual seminar paper as a reproduction of a published scientific paper.
Assessment methods	Seminar paper as a reproduction of the selected paper and final exam-written (done at home for 3-4 days).

Teaching units	**Duration**
Main principles and methodology applied in the approach to environmental risk analysis. Hydrological risk analysis: stochastic approach to risk balancing, benefit; avoiding and recognition of risk; recognition of threats; physical/chemical characteristics and trends and methods of exposure, structure-activity dependence; exposure assessment: estimation of human and animal epidemiological data, exposure directions; exposure assessments: identification of the pollution source, paths and analysis of consequences (transport of pollutants), evaluation of concentrations in the environment, analysis of the population, modelling of the exposure level and estimation of non-reliability, characteristic features of risk; risk management: regulatory actions and options, social and economic influence on risk management.	30

Theory of Risk Assessment in Environmental Engineering GAHA02 6.0	Prof. Roko Andričević, PhD Assistant Professor Veljko Srzić, PhD	**Lectures** • 30 hours of lectures with the use of developmental programmes **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Written. **Terms** By agreement

Course title	KARST WATER RESOURCES
Code	GAHA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ognjen Bonacci, PhD
Learning outcomes and competences	The student will be able to: • synthetise the specificity of kart area for the purpose of proposing and creating protection measures of water resources, • Formulate models for assessment of the state of karts water resources, • predict the effects of pressures on karts water resources, • connect and improve various offered solutions to numerous practical and theoretical problems related to karts water management.
Recommended literature	(1) O. Bonacci, Karst hydrology, Springer Verlag, Berlin 1987. (2) O. Bonacci, Posebnosti krških vodonosnika, Građevinski godišnjak ¾, Zagreb, 2004: 91-187.
Supplementary literature	(1) D. Ford, P. Williams, Karst geomorphology and hydrology, Unwin Hyman, London, 1989. (2) J. Gunn (urednik), Encyclopedia of caves and karst science, Fitzroy Dearborn, New York
Teaching methods	Oral lectures, PowerPoint presentations.
Assessment methods	Oral exam, seminar paper, thesis.

Teaching units	**Duration**
Definition of karst. Soluble karts-forming rocks, closed protrusions on the surface of the rocks, water circulation in karst, karst springs, rifts, open water streams in karst, water in karst coastal areas, karst fields and their water balance, karst aquifer.	30

Karts Water Resources GAHA03 6.0	Prof. Ognjen Bonacci, PhD	**Lectures** • 30 hours of lectures **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. **Terms** By agreement

Course title	ECOHYDROLOGY
Code	GAHA04
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ognjen Bonacci, PhD
Learning outcomes and competences	The student will be able to: • connect the basic principles of ecology and hydrology for the solution of various engineering problems in ecohydrology, • formulate the main interaction relationship between the eco-system and hydrological cycle and anticipate their strength with respect to anthropogenic influences and other pressures on both systems, • organise regulatory relationship between hydrological and ecological processes based on the integral systematic approach (integral basin management). • anticipate water availability in the future and the level of generated stress on the living environment in water shortage..
Recommended literature	O. Bonacci: Ekohidrologija, Građevinski fakultet Split, 2003.
Supplementary literature	O. Bonacci: Oborine-glavna ulazna veličina u hidrološki ciklus, Geing, Split, 1994.
Teaching methods	Lectures and seminars with the use of state-of-the-art devices (computer work).
Assessment methods	Oral exam, orally presented seminar.

Teaching units	**Duration**
Relationship between hydrology and ecology Concept of sustainable development. Definition of ecohydrology. Elements of hydrology and water resources essential for ecology. Hydrological systems and processes. Influence of global climate change on hydrological cycle. Floods, flooded and damp areas. Dryness, drought, scant rainfall areas. Open water streams as part of eco-system. Open water stream management. Environmental needs for open water streams water. Environmental needs for open water streams water. Principles and methods for ecologically acceptable flow definition. Methods of determining ecologically-friendly water flow.	30

Ecohydrology GAHA04 6.0	Prof. Ognjen Bonacci, PhD	**Lectures** • 30 hours of lectures **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Orally presented seminar. **Terms** By agreement

Course title	HYDROLOGICAL MODELLING IN KARST
Code	GAHA05
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Vesna Denić-Jukić, PhD
Learning outcomes and competences	Upon completing the exam, the student will be able to: • set and create hydrological models in karst • synthetise developed models on the new research area, • connect the concepts of water balance from the aspect of karts basins, • formulate and implement the verification and model calibration procedures.
Recommended literature	(1) O. Bonacci, Karst Hydrology, Springer Verlag, Heidelberg, 1987.; (2) V.P. Singh, Hydrologic Systems, Rainfall-Runoff Modeling, Prentice Hall, 1988.; (3) Metka Petrič: Characteristics of recharge–discharge relations in karst aquifer, Inštitut za raziskovanje krasa ZRC SAZU, Založba ZRC, Postojna-Ljubljana, 2002.
Supplementary literature	(1) Mc Cuen: Hydrologic analysis and design, Prentice Hall, 1989.; (2) M.P. Wanielista, Hydrology and water quantity control, John Wiley & Sons, 1990.
Teaching methods	Lectures and seminars with the use of state-of-the-art devices (computer work).
Assessment methods	Oral presentation of the seminar paper. Oral exam.

Teaching units	**Duration**
System approach: definitions and concepts. Problems and models in hydrology. Linear, time-variant and nonlinear models. Black box and conceptual models	6
Catchment runoff modelling	4
System unit response characteristics. Models for ungauged catchments	2
Analysis of the recession part of the hydrograph. Modelling parameters	4
Balance of groundwater in the ground. Conceptual models of karst water balance	4
Characteristics of recharge-discharge relations in karst aquifers	4
Determination of catchment areas and runoff coefficients.	4
Model calibration and verification. Efficiency coefficient.	2
Composition of research seminar paper.	60

Hydrological Modelling in Karts (GAHA05) 6.0	V. Denić-Jukić V. Denić-Jukić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral. **Terms** By agreement

Course title	MARINE HYDRAULICS, SPECIAL CHAPTERS
Code	GAHA06
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Assistant Professor Nenad Leder, PhD
Learning outcomes and competences	The student will be able to: • determine the influence of surface waves cause by wind in the littoral area, • determine the influence of sea currents in the littoral area, • assess the influence of pollution in the littoral area • assess the influence of modelling and dimensioning of coastal buildings on environment protection, • by critical reasoning select the concept of numerical and physical modelling of littoral processes.
Recommended literature	(1) R.G. Dean, R.A. Dalrymple: Water Wave Mechanics for Engineers and Scientists, Prentice-Hall, Inc., 1984.; (2) B. LeMehaute, D.M. Hanes: The Sea, Ocean Engineering Science, Vol. 9, John Wiley&Sons Inc., 1990.; (3) J.W. Kamphuis: Physical Modelling of Coastal Processes, Advances in Coastaland Ocean Engineering (Ed. P.L.-F. Liu), Vol. 2, Word Scientific, 1996; (4) B. Cushman-Roisin et al. (Eds): Physical Oceanography of the Adriatic Sea, Kluwer, Dordrecht, 2001.; (5) B. Johns: Physical Oceanography of Coastal and Shelf Seas, Elsevier OceanographySeries, Vol. 35, 1983.; (6) W.J. Emery, R.E. Thomson: Data Analysis Methods in PhysicalOceanography, Pergamon, 1998.; (7) D.T. Pugh: Changing Sea Levels. Effect of Tides, Weather and Climate, Cambridge University Press, 2004.; (8) A.B. Rabinovich: Long Ocean Gravity Waves: Trapping, Resonance and Leaking (inRussian), Gidrometeoizdat, St. Petesburg, 1993.
Supplementary literature	(1) N. Leder, A. Smirčić, I. Vilibić: Extreme values of surface wave heights in the northern Adriatic, Geofizika, 15, 1-13, 1998.; (2) I. Vilibić, N. Leder, A. Smirčić: Storm surges in the Adriatic Sea: An impact on the coastal infrastructure, Periodicum Biologorum, 102, Suppl. 1, 483-487, 2000.; (3) N. Leder, M. Orlić: Fundamental Adriatic seiche recorded by currentmeters, AnnalesGeophysicae, 22, 1449-1464, 2004.; (4) N. Leder: Primjena spektralne analize, analize sistema i rotacione spektralne analize u oceanologiji i meteorologiji, Hidrografski godišnjak 1990 1991, Split, 19 36, 1992.; (5) I. Vilibić, N. Leder, A. Smirčić, Z. Gržetić: Dugoročne promjene razine mora na hrvatskoj obali Jadrana, Tisuću godina prvoga spomena ribarstva u Hrvata, Hrvatska akademija znanosti i umjetnosti, (urednik B. Finka), Zagreb, 437-445, 1997.; (6) I. Vilibić, N. Domijan, M. Orlić, N. Leder, M. Pasarić: Resonant coupling of a travelingair-pressure wave with the east Adriatic coastal waters, Journal of Geophysical Research – Oceans, 109, C100001, doi:10.1029/2004JC002279, 2004.
Teaching methods	Lectures and seminars and experimental field work.
Assessment methods	Assessment of practical seminars and oral exam.

Teaching units	**Duration**
Special topics in physical oceanography: theory of waves, currents and mixing processes (transport of matter), coastal oceanography. Wind-generated surface waves, log sea-level oscillations and currents in the Adriatic Sea. Resonant oscillations in the Adriatic Sea. Tsunami. Spectral analysis. Theory of extremes. Numerical and physical modelling. Physical oceanography in relation to hydraulics projects in the sea and coast. Field measurements.	30

Marine Hydraulics, special chapters (GAHA06) **6.0**	N. Leder N. Leder	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral. **Terms** By agreement

Course title	SYSTEM ENGINEERING IN WATER RESOURCES MANAGEMENT
Code	GAHA07
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Margeta, PhD
Learning outcomes and competences	The student will be able to: • apply the systematic approach and systematic analysis to solving engineering problems related to design and operation of water tanks • plan and design water tanks in solving water use problems, protection from harmful effect of waters and protection of waters • formulate mathematical stochastic and deterministic models of water tanks and apply the tools of systemic analysis in design and water tank management problem solving • set forth a model for simulation of water tank operation with the aim of solving various water-related problems • formulate optimisation models for solving engineering problems in planning, design and water tank management • prepare data necessary for planning and design of water tanks • anticipate the influence of water tanks on environment and define protection measures
Recommended literature	(1) Margeta, J.: Osnove sistemskog inženjerstva vodnih resursa, Građevinski fakultet, Split, 1993; (2) Margeta, J., Uvod u sistemsko inženjerstvo u projektiranju i upravljanju akumulacijama, Split, 1988.; (3) Margeta, J.: Osnove gospodarenja vodama, G.F. Split, 1992.; (4) Margeta J.:Smjernice za integralni pristup razvoju, gospodarenju i korištenju vodnih resursa, 1999.
Supplementary literature	(1) Smith A.A., E. Hinton, R.W. Lewis: Civil Engineering Systems Analysis and Design, John Willey amd Sons, New York, 1983.; (2) Gillet, B.E.: Introduction to Operation Research, McGraw Hill, New York, 1976.; (3) J. Margeta: Projektiranje i upravljanje volumenima vodospremišta, Građevinski fakultet, Split, 1994.; (4) McMahan, T.A.: Reseroir Capacity and Yield. Elsevier Scientific Publishing Company, Amsterdam, 1978. (5) Moran, P.A.P.: The Theory of Storage, Methuen, London, 1959.
Teaching methods	Lectures with the use of state-of-the art devices. Practical work in problem solving and independent design of programme and homework.
Assessment methods	Oral and written exam, continuous evaluation.

Teaching units	**Duration**
Water tanks and their role in water management and maintenance of sustainable water supply, food and energy production, protection from floods and droughts and water environment. The main principles water tanks design theory: planning of water resources and water tanks, main characteristics of tanks considering their capacity, volume equations. System approach to planning and design of the tank volume. Methods for determining the tank capacity; computation by applying the balance equation, methods of the critical period, methods of low water levels, methods of the probability matrix, methods based on generated data, simulation and optimisation methods. System engineering - main definitions. Formulation of	30

optimisation problems. Introduction to linear programming. Main principles of linear programming. Application of linear programming to the tank design and management and to other water resources problems. The concept of dynamic programming. One-dimensional dynamic programming. Multi-dimensional dynamic programming. Special types of dynamic programming. Application of dynamic programming to the tank design and accumulation management and to the solution of other problems related to water resources.	

System Engineering in Water Resources Management (GAHA07) 6.0	J. Margeta J. Margeta	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area.. **Exam** Oral presentation of the seminar paper. Written and oral exam. **Terms** By agreement

Course title	SUSTAINABLE URBAN WATER SYSTEMS
Code	GAHA08
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Jure Margeta, PhD
Learning outcomes and competences	The student will be able to: • formulate the assessment of sustainability of urban water system • apply system approach and system analysis in problem solving of sustainable urban water system • synthetise interpolation measures into existing urban water systems in line with the principles of sustainable development and sustainable living in urban environments • anticipate the influence of climatic changes on the work of urban water systems including the work of waste water purification device, influence on the environment and formulate measures for the increase of the level of sustainability and its adjustment in the future • anticipate the influence of climatic changes on the work of littoral urban water systems and formulate the measures for the increase of the level of sustainability and its adjustment to the expected increase of median water level • combine existing and develop new social and technological measures for increasing the level of sustainability of urban water systems
Recommended literature	(1) Margeta, J.: Osnove sistemskog inženjerstva vodnih resursa, Građevinski fakultet, Split, 1993.; (2) UNEP: Integrated Coastal Urban water System Planning in Coastal Areas of the Mediterranean, 2007. ; (3) Margeta J.:Smjernice za integralni pristup razvoju, gospodarenju i korištenju vodnih resursa, 1999.
Supplementary literature	(1) CIRIA; C523 Sustainable Urban Drainage Systems – Best Practice Manua, 2001; Haugton, G. and Hunter, C. Sustainable Cities, Jassica Kingsley, London, 2001.
Teaching methods	Lectures with the use of state-of-the art devices. Practical work in problem solving and independent design of programme and homework.
Assessment methods	Oral and written exam, paper, continuous evaluation.

Teaching units	**Duration**
Sustainable development and climatic changes. Urban environments, sustainability of living in urban environments, sustainable urban water system. Integral urban water system. Urban water system water balance, vertical water balance in rainfall water eco-drainage system; Renewable energy sources and urban water system; Tasks related to management of sustainable urban water systems; Integration with other management processes; Planning of integral urban water system in line with the concept of sustainable development; Techniques and tools for decision-making support; Managing requirements; Techniques of urban water cycle; Design of water-sensitive urban environments; Risk management.	30

Sustainable Urban Water Systems (GAHA08) **6.0**	J. Margeta J. Margeta	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Written and oral exam. **Terms** By agreement

Course title	SELECTED CHAPTERS ON KARST HYDROGEOLOGY
Code	GAHA09
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher in terms with their long experience in postgraduate study teaching: Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ognjen Bonacci, PhD
Learning outcomes and competences	The student will be able to: • organise the characteristics of karst morphological phenomena and connect them with underground water flow. Organise various terrains in relation to water permeability. • combine findings from karst morphology and terrain water permeability for proposing the zones of sanitary protection. • present hydrodynamic karst zones. • implement the procedures of calculating water loss from karst accumulations.
Recommended literature	(1) P. A. Domenico & F. W. Schwartz (1997): Physical and Chemical Hydrogeology. J. Wiley & Sons, Inc.p 506, New York. (2) M. Herak (1957): Geološka osnova nekih hidroloških pojava u dinarskom kršu. Zbornik II. kongr. geol. Jug., 523-535, Sarajevo. (3) M. Herak (1986): Geotektonski okvir zaravni u kršu. Acta Carsologica XIV/XV, 13-18, Ljubljana. (4) M. Herak (1990): Geologija. V. izdanje. Šk. knjiga, p. XV+433, Zagreb. (5) M. Herak, S. Bahun & A. Magdalenić (1969): Pozitivni i negativni utjecaji na razvoj krša u Hrvatskoj. Krš Jug. 6, 45-78, Zagreb. (6) S. Bahun (1978): Model razvoja hidrogeologije nekih polja u dinarskom kršu. Zbornik IX. kongr. geol. Jug., 855-861, Sarajevo. (7) A. Stepinac (1969): Otjecanje u dinarskom kršu. Krš Jug. 6, 207-235, Zagreb. (8) S. Šestanović (1979): Mogućnost kvantitativnog definiranja vodopropusnosti akumulacije Buško Blato. Zbornik RGN fakulteta, 363-377, Zagreb. (9) S. Šestanović (1985): Graditeljski zahvati i zaštita voda u kršu. Naš krš XI/18-19, 33-38, Sarajevo. (10) S. Šestanović (1986): Utjecaj građevinskih objekata izvan urbaniziranih područja na vodne resurse u kršu. Acta Carsologica XIV/XV, 241-244, Ljubljana.
Supplementary literature	(1) D. Mayer (1993): Kvaliteta i zaštita podzemnih voda. Hrvatsko društvo za zaštitu voda i mora, p 146, Zagreb. (2) K. Urumović (2003): Fizikalne osnove dinamike podzemnih voda. RGN Fakultet Zagreb, 318 str., Zagreb. (3) M. E. Aljtovski (1973): Hidrogeološki priručnik. Građevinska knjiga, 616 str., Beograd. (4) Pollak, Z. (1995): Hidrogeologija za građevinare. Poslovna knjiga, 206 str., Zagreb
Teaching methods	Lectures with videos and PowerPoint presentations. Supervision of the research seminar in the field, consultations.
Assessment methods	Oral exam with analysis and defence of research seminar report.

Teaching units	**Duration**
Geotectonics and karst. Development of the relief and groundwater flow in karst. Phases of karstification and morphological phenomena in karst. Positive and negative effects upon karst development; formation and development of karst fields and hydrogeological phenomena in the underground areas. Water losses from karst accumulations.	30

Selected Chapters on Karst Hydrogeology GAHA09 6.0	Prof. Ognjen Bonacci, PhD	**Lectures** • 30 hours of lectures • **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar. **Terms** By agreement

Course title	INTRODUCTION TO ENGINEERING NUMERICAL MODELLING
Code	GAHA10
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Associate Professor Hrvoje Gotovac, PhD
Learning outcomes and competences	The student will be able to: • make a mathematical model of engineering problems • formulate and make a numerical model of engineering problems by finite differences method • formulate and make a numerical model of engineering problems by using finite elements technique • formulate and make a numerical model of engineering problems by using point and sub-area collocation method • analyse stationary and non-stationary engineering problems by using the aforementioned numerical methods • analyse engineering problems by using the Lagrangian ("Random walk") and Euler-Lagrangian methods • analyse engineering problems by using the Monte-Carlo method • analyse the accuracy and stability of numerical solutions
Recommended literature	(1) Jović V. (1993.), *Uvod u inženjersko numeričko modeliranje, Aquarius Engineering,* (2) Zheng C., Bennet G. D. (2002), *Applied Contaminant Transport Modelling*, John Wiley and Sons, (3) Saad Y. (2003), *Iterative methods for sparse linear systems*, SIAM. (4) Ascher U.M., Petzold L.R. (1998), *Computer methods for ordinary differential equations and differential-algebraic equations.* SIAM.
Supplementary literature	(1) Kaliakin V. N. (2002), *Introduction to approximate numerical solution techniques, numerical modeling and finite element methods, Marcel Dekker.* (2) Gotovac H.,, Andričević R., Gotovac B. (2007) Multi-resolution adaptive modeling of groundwater flow and transport problems, Advances in Water Resources (30), 1105-1126.
Teaching methods	Lectures with the use of a projector and computer, writing of the seminar paper with the supervisor's assistance on the computer and cluster.
Assessment methods	Oral exam. Oral presentation and defence of the seminar paper.

Teaching units	**Duration**
Introduction. Functional approximations. Approximate solutions of differential equations; procedures of strong and non-strong formulation. Method of finite differences (MODFLOW formulation in underground water flow). Galjerkin`s formulation and method of the conservation law. Method of point collocation. Method of sub-area collocation. Finite elements technique. Modelling of the stationary heat conductivity by using the method of finite elements (Konelib library), Modelling of planar state of strain and deformation and modelling of prismatic bar torsion (Konelib). Explicit, mixed and implicit procedures of numerical time integration. Modelling of non-stationary product conductivity by using the method of finite elements (Konelib), Solving large linear and non-linear equation systems (frontal procedure, conjugate gradients method, GMRES, Newton` method). Adaptive procedures. Stability and accuracy of the numerical solution. Modelling of non-stationary transport of the mass by using Lagrangian ("Random Walk Particle Tracking") and Euler-Lagrangian methods. Monte-Carlo method.	30

Introduction to Engineering Numerical Modelling GAHA10 6.0	Associate Professor Hrvoje Gotovac, PhD	**Lectures** • 30 hours of lectures **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement

Course title	ANALYSIS OF HYDROLOGICAL TIME SERIES
Code	GAHA11
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study = 3.2 ECTS; Composition of research seminar paper = 2.0 ECTS.
Teachers and/or associates	Prof. Damir Jukić, PhD
Learning outcomes and competences	Upon the completed exam, the student will be able to: • write an analysis of time series by descriptive techniques • propose adequate models of time series • propose prognostic models • propose time series in frequency domain
Recommended literature	(1) Chris Chatfield: The Analysis of Time Series: An Introduction, Sixth Edition, Texts in Statistical Science, 2003.
Supplementary literature	(1) George E. P. Box, Gwilym M. Jenkins, and Gregory C. Reinsel: Time Series Analysis: Forecasting and Control, Wiley Series in Probability and Statistics, 2008. (2) A.R. Rao and E.-C. Hsu: Hilbert-Huang Transform Analysis of Hydrological and Environmental Time Series, Water Science and Technology Library, 2008. (3) Shumway R.D., Stoffer D.S.: Time Series Analysis and Its Applications, Springer Verlag, 2000. (4) Napler Addison: The Illustrated Wavelet Transform Handbook, 2002.
Teaching methods	Seminar paper presentation with state-of-the-art devices and discussions with students; individual work with students.
Assessment methods	Oral exam, oral presentation.

Teaching units	**Duration**
Introduction: hydrological and climatic time series and their characteristics, basic terminology goals and approaches to the analysis of hydrological time series. Unilateral descriptive techniques: types of time series, analysis of trending series, graphical illustration and comparison of time series, analysis of series with seasonal variations, auto-correlation and correlogram, cross-correlation, partial correlation, regression, graduation of series. Models of hydrological time series: stochastic processes and their characteristics, stationary processes, "white noise", characteristics and assessment of auto-correlation function, AR, MA, ARMA and ARIMA models, Box-Jenkins seasonal ARIMA model, adjustment and assessment of model parameters, analysis of residual values. Prognostic models, overview of prognostic procedures and their comparison. Analysis of hydrological time series in frequency domain: spectral analysis, periodogram, spectral density function, cross-spectral density function, transfer function.	30

Analysis of Hydrological Time Series GAHA11 6.0	Prof. Damir Jukić, PhD	**Lectures** • 30 hours of lectures **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar. **Terms** By agreement

Course title	TRAFFIC FLOW THEORY
Code	GAPA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Dražen Cvitanić, PhD
Learning outcomes and competences	The student will be able to: • select traffic flow parameters required for analysis (time of sequence, critical time gap, free flow speed…) • assess and develop analytical models of traffic flow at intersections without signalling lights • assess and develop analytical models of traffic flow at intersections with signalling lights • assess and develop analytical models of traffic flow at roundabout intersections • assess and develop analytical models of traffic flow of extra-urban roads • assess and develop simulation models of traffic flow
Recommended literature	(1) D.R. Drew: *Traffic Flow Theory and Control*, McGraw-Hill, New York 1968. (2) *Traffic flow theory*, Transportation Research Bord 1998. (3) F.A. Haight: *Mathematical Theories of Traffic Flow*, Academic press, London 1963 (4) Cvitanić, D:Teorija prometnog toka, Split 2008, course exam notes na web stranama fakulteta, (5) Roger P. Roess, Elena S. Prassas, William R. McShane: Traffic Engineering (2004.).
Supplementary literature	(1) Cvitanić, D.: *Modeliranje kapaciteta i razine usluge nesemaforiziranih raskrižja*, Građevinski fakultet Sveučilišta u Splitu, Magistarski rad, Split 2000. (2) Breški, D.: *Usporedba analitičkih i simulacijskih modela za analizu funkcioniranja semaforiziranih raskrižja*, Magistarski rad, Split 2000.
Teaching methods	Lectures with the use of state-of-the-art devices. Work with software for the analysis of traffic flow on the elements of the traffic network, supervised writing of the seminar paper.
Assessment methods	Oral exam with the presentation of the seminar paper.

Teaching units	**Duration**
Traffic stream characteristics. Traffic flow, density, speed, spatial and temporal gaps. Measurement at a point; measurement over a short section.	5
Two and three-dimensional speed-flow-density models.	5
Human factors (perception-response time, braking inputs, acceleration, deceleration..). Influence of gender, age and trip purpose on the flow.	5
Car sequence models. Lane changing models. Macroscopic traffic flow models.	5
Analytical models and application of queuing theory. Theory of recognising time gaps. Critical time gaps. Saturated flow. Analysis models of functioning of non-signalised and signalised intersections.	5
Simulation traffic flow models.	5
Composition of research seminar paper.	60

Traffic Flow Theory GAPA01 6.0	D. Cvitanić D. Cvitanić	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam with the presentation of the seminar work. **Terms** By agreement

Course title	HIGHWAYS – SELECTED CHAPTERS
Code	GAPA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Associate Professor Deana Breški, PhD
Learning outcomes and competences	The student will be able to: • present basic theories of vehicle circulation and forces affecting the vehicle • determine optimal route elements with regard to the category of the highway, filed conditions, lateral impact, visibility, etc. • select and design the optimal type of intersections with all pertaining elements • justify the selection of the model and procedure of traffic analysis • determine the maximum capacity of road network elements by using different models • select the model of road management
Recommended literature	(1) *A Policy on geometric design of Highways and streets*, AASHTO 2001. (2) McShane,W.R. Roess, R.P., Prassas,E.S.: *Traffic engineering*, Prentice Hall, 2004. (3) Maletin, M.: *Planiranje i projektovanje saobraćajnica u gradovima*a, Orion art, 2009.
Supplementary literature	(1)*Transportation Impact Analyses for Site Development*, Institute of Transportation Engineers (ITE), 2005. (2) Pađen, J.: *Osnove prometnog planiranja*, Informator, Zagreb, 1986.
Teaching methods	Lectures with the use of state-of-the-art devices.
Assessment methods	Seminar paper, oral presentation, Oral exam.

Teaching units	**Duration**
The role of traffic in planning. Main theories on vehicles circulation. Management and maintenance of roads. Environmental protection. Assessment of potential pollution. Protective measures. General considerations in planning and design. Cross-road types. Design elements. Routing of traffic flows. Traffic islands. Traffic control. Flow capacity. Level cross-roads. Cross-roads beyond the level. Classification of the sources of conflict points. Theoretical form of the function for inflow-outflow levels/ramps. Traffic consideration. Geometrical formation of descending-ascending level crossings. Flow capacity of the intersections. Classification of intersections. Criteria for the selection of intersections.	4
Division and classification of urban and suburban roads. Development and application of the concept of the design of urban and suburban roads.	2
Design elements: visibility, horizontal and vertical flow; cross-section elements. Division of traffic flows. Alignment of street and road route.	6
General remarks on modern design methods. Use of computers in design.	2
Types of intersections, design elements, routing of traffic flows, traffic control.	6
Maximum road capacity, traffic analysis procedure.	6
Management and maintenance of roads.	4
Composition of research seminar paper.	60

Highways – selected chapters GAPA02 6.0	D. Breški D. Breški	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Seminar paper presentation and oral exam **Terms** By agreement

Course title	TRANSPORT PLANNING
Code	GAPA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Dražen Cvitanić, PhD / Associate Professor Deana Breški, PhD
Learning outcomes and competences	The student will be able to: • select parameters of the traffic model required for analysis • assess and develop the models of travel generation • assess and develop models travel split • assess and develop models of travel assignment
Recommended literature	(1) B.Y. Hutchinson: Principles of Urban Transport Systems Planning, Book Company, 1974. (2) J. Pađen: Osnove prometnog planiranja, Informator, Zagreb, 1986. Transportation planning handbook, ITE 2005.
Supplementary literature	R. Lane, Powel, T.J.: *Analytical transport planning*, Redword Burn Limited 1974.
Teaching methods	Lectures with the use of state-of-the-art devices. Work with software for transport planning, supervised writing of the seminar paper.
Assessment methods	Oral exam with the presentation of the seminar paper.

Teaching units	**Duration**
Transport planning history. Interaction between transport and other activities. Travel demand forecast.	5
Modelling of road network with intersections. Zoning, placing centroids, zone properties.	5
Trip generation models; application of multi-dimensional regression analysis, category analyses, logistic analyses.	5
Models of selection of transport means. Utility models.	
Models of travel split between the zones; Fratar`s method, gravity model, opportunities model.	5
Route assignment models: capacity restrain models; multi-route assignment models. Model calibration.	5
Composition of research seminar paper.	60

Transport planning GAPA03 6.0	D. Cvitanić, D. Breški D. Cvitanić, D. Breški	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral exam with the presentation of the seminar paper. **Terms** By agreement

Course title	SELECTED CHAPTERS OF ROCK MECHANICS
Code	GAGA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Predrag Miščević, PhD
Learning outcomes and competences	The student will be able to: • critically assess and improve the measurement methods of crack, rock and rock mass parameters required for solving engineering problems in rock masses • independently re-evaluate the classifications of rock mass • develop rock mass models • devise rock mass improvement methods • select and plan complex foundations on rock mass • create new methods of analysis of high rock mass slopes • develop rock mass design based on observation methods
Recommended literature	(1) Hudson J.A. & Harrison J.P. (1997.), *Engineering rock mechanics, an introduction to the principles*, Pergamon. (2) Duncan C. W. (1999.), *Foundation on Rock*, E & FN Spon, second edition. (3) Hoek E. & Brown E.T. (1980.), *Underground Excavations in Rock*, Institute of Mining and Metallurgy, London.
Supplementary literature	(1) Hanna T.H. (1982.), *Foundations in tension, ground anchors*, Trans Tech Publications. (2) Hoek E. & Bray J.W. (1974.), *Rock slope engineering*, The Institution of Mining and Metallurgy, E & FN Spon. (3) Goodman R.E. (1989.), *Introduction to Rock Mechanics (second edition)*, John Wiley & Sons.
Teaching methods	Lectures with the sue of a video projector with a computer, supervised writing of the seminar paper, and performance of laboratory testing.
Assessment methods	Oral presentation of the seminar paper. Oral exam.

Teaching units	**Duration**
Content of investigative works for design and construction of structures in rock mass. Design principles for foundations, rock slopes, retaining constructions and underground excavations (geological engineering model – geotechnical model – numerical model). Use of numerical model on examples of foundation on rock, rock slopes, retaining structures with bolts and underground excavations. Observations of constructions in the rock mass. Interpretation of the measured results.	6
Correlation between engineering geological characteristics (cracks, percentage of core, RQD) and geotechnical characteristics of the rock mass.	6
Rock and rock mass models.	2
Improvement (reinforcement) of rock masses (drainage, bolting, grouting).	4
Guidelines for design and measurement of foundations, high rock slopes, retaining constructions and underground excavations (geological engineering model – geotechnical model – numerical model).	4
Use of numerical methods at foundation, securing high rock slopes, retaining structures with bolts and underground excavations.	6
Observations of structures in rock mass and interpretation of the measured results.	2
Composition of research seminar paper.	60

Selected chapters of Rock Mechanics GAGA01 6.0	P. Miščević P. Miščević	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area.. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	SOIL MECHANICS MODELS
Code	GAGA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Tanja Roje-Bonacci, PhD
Learning outcomes and competences	The student will be able to: • critically assess the most recent findings available in the existing literature with special emphasis on the area of small deformities; • comment on mutual relations, implementation advantages and disadvantages of known and acknowledged soil models; • independently determine, on the existing equipment in the laboratory, the input parameters for some of the known soil models; • assess and apply gained laboratory data on idealised numerical soil model; • assess gain solutions by comparing several variants; express substantiated opinion on the possibility of adjusting theoretical solutions for solving natural phenomena in geotechnics, which are appropriate for subject research.
Recommended literature	(1) Mechanics of Geomaterials: Rocks, Concrete, Soils, Z.P. Balant ed., John Wiley & Sons, Inc., New York, 1985. (2) Naylor, D.J., Pande, G.N., Simpson, B., Tabb, R.: Finite Elements in Geotechnical Engineering, Pineridge Press Ltd., Swansea (UK), 1981.
Supplementary literature	(1) Roscoe, K.H., Burland, J.B.:. *On the generalised stress-strain behaviour of an idealised wet clay*. U: Heineman i Leckie (ur.), Engineering plasticity, (1968), Cambrige University Press, 535-609. (2) Chen, W.F.,: *Limit analysis and soil plasticity*. Elsevier, New York, 1975. (3) Chen, W.F., Saleeb, A.F., *Constitutive Equations for Engineering Materials*. *Vol 1- Elasticity and Modeling*, Wiley, New York, 1982. (4) GeoSlope, *Manual Sigma/W define*, version 5.01. (5) ABAQUS, *Theory Manual version 6.3*. (6) Mihanović, A:, Marović, P., Dvornik, J.: *Nelinearni proračuni armirano betonskih konstrukcija.* Društvo hrvatskih građevinskih konstruktora, Stručna biblioteka, Serija priručnici, knjiga 7, Zagreb, 1993. (7) P.I.S.A. *Program for incremental stress analysis*; Elastic models, Plastic models, Critical state models. (8) Atkinson, J.H.; Bransby, P.L.: 1978. *The mechanics of soils, An introduction to critical state soil mechanics*, McGrow-Hill, London. (9) Britto, A.M., Gunn, M.J., 1987. *Critical State Soil Mechanics via Finite Elements*, John Wiley and Sons. (10) Časopisi: Geotechnique; Engineering Modelling; Soils and Foundations; Journal of Solis Mech. And Fuond. Engineering, ASCE.
Teaching methods	Lectures, seminar paper, laboratory testing of sample properties. Solving of a practical problem by numerical methods.
Assessment methods	Oral presentation of laboratory work, seminar paper, presentation of numerical calculations. Oral exam.

Teaching units	**Duration**
Main principles of the mechanics of the continuum. Soil as a two-phase continuum. Differential equation of balance and motion. Simple constitution equations for the soil. Influence of non-linearity on the soil behaviour. Drainage and non-drainage conditions; water flow in soil and consolidation. Boundary and initial conditions. Main rules in numerical modelling for geotechnical operations. Constraints and criteria. Non-linear soil models and finite element method. Computer programmes: requirements and possibilities. Selection of input data. Critical approach to problem simplification. Acceptability of the results of numerical analysis. Numerical modelling of complex geotechnical operations: embankments, anchoring supporting structures etc.	30

Soil Mechanics Models GAGA02 6.0	Prof. Tanja Roje-Bonacci, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	SPECIAL CHAPTERS IN FOUNDATION ENGINEERING
Code	GAGA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Tanja Roje-Bonacci, PhD
Learning outcomes and competences	The student will be able to: • assess the condition of technology of performance of unusual foundation methods form the available literature; • assess the most recent improvement possibilities of sub-foundation soil and critically review them; • model unusual foundation and improvement of sub-foundation soil for the same geotechnical conditions and set parameters; • compare and assess on a specific example all aspects of quality and effect of unusual foundation and improvement of sub-foundation soil; • test the effects of change of value and specific input data in a certain model of unusual foundation and/or improvement of foundation soil • select the most favourable solutions in complex conditions of foundation.
Recommended literature	(1) Fang, H.-Y.: Foundation Engineering Handbook, Chapman & Hall, London, 1991. (2) Zeevaert. L.: Foundation Engineering for Difficult Subsoil Conditions, Van Nostrand Reinhold Company, New York, 1973. (3) Agatz, A.; Lackner, E.: Erfarungen mit Grundbauwerken, Springer – Verlag, Berlin, 1977.
Supplementary literature	(1) Desai, C.S.. Christian, J.T.: Numerical Methods in Geotechnical Engineering, McGraw-Hill Book Company, New York, 1977. (2) Bowles, J.E.: Foundation Analysis and Design, McGraw-Hill Book Company, New York, 1988. (3) Kany, M.: *Berechnung von Flächengründungen,* Wilhelm Ernst&Sohn, 1974, Berlin. (4) Prudon, L. *Traveau maritime, Bibliothèque de l'ingénieur de travaux publics,* Dunod, 1936. Paris.
Teaching methods	Lectures, composition of the seminar paper with target subject-matter, composition of a design at the level of study from the target area.
Assessment methods	Written seminar paper, written-graphic study and its oral presentation. Oral exam.

Teaching units	**Duration**
Foundations of silos and reservoirs; towers, chimneys, transmission lines and antenna columns, foundations of arch bridges, suspended and other types of bridges (cofferdams and abutments/piles); deep massive foundations, foundations in deep water (docks, platforms; coastal structures, foundations and transfer of horizontal forces; overcoming buoyancy for immersed structures (dry docks, rafts, dam superelevation). Correction of sloped/inclined structures. Change of stress in the structure due to the development of settlement with time. (The course contents will be adapted to the candidates' requirements since it is too complex for the proposed timetable).	30

Special chapters in Foundation Engineering GAGA03 6.0	Prof. Tanja Roje-Bonacc, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	RHEOLOGY OF MATERIALS
Code	GAMT01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Associate Professor Sandra Juradin, PhD
Learning outcomes and competences	The student will be able to: • develop and select options of rheological concrete models • develop and select options of rheological special concrete models • assess functional ties between spatial and rheological properties of concrete • select the composition of concrete based on required spatial model of normal and special concrete • recommend the type rheometer for certain tests • assess gained results
Recommended literature	(1) Powers, T.C.: The Properties of Fresh Concrete, J.Willey and Sons, 1968., (2) Krstulović, P.; Juradin, S.; Reologija materijala, skripta (3) Bartos, P. J. M.: Special Concretes, workability and mixing, proceedings of the international RILEM workshop, Paisley, Scotland, 1993
Supplementary literature	(1) Banfill, P. F.G.: Rheology of Fresh Cement and Concrete, Proceedings of the International Conference organized by the British Society of Rheology, Licerpool, UK 1990. (2) Krstulović, P: Svojstva i tehnologija betona, Građevinski fakultet Sveučilišta u Splitu i Institut građevinarstva Hrvatske, Split, 2000. (3) Tattersall, G.H.: The Workability of Concrete, Cement and Concrete Association, Wexham Springs, Slough, 1976. (4) Reiner, M.: Deformation, Strain and Flow, H. K. Lewis & Co., London, 1969 (5) Ferraris, C.F.; de Larrard F.; Martys, N.: Fresh Concrete Rheology – Recent Developments, to be published in Materials Science of Concrete, Volume VI (6) Hackley A.V.; Ferraris, C.F.: Guide to Rheological Nomenclature: Measurement in Ceramic Particular Systems, NIST Special Publication 946, National Institute of Standards and Technology, Gaithersburg, 2001 (7) Whorlow, R.W.: Rheological Techniques, John Willey & Sons – Ellis Horwood Ltd, Chichester, England, 1980.
Teaching methods	Lectures and seminars with the use of state-of-the-art devices (computer work), laboratory.
Assessment methods	Oral exam, Oral presentation of the seminar paper.

Teaching units	**Duration**
Rheological models	30
Applied concrete rheology	
Viscosity and boundaries of flow: determination methods	
Concrete, suspension and coat rheology.	
Design of rheometer for liquid concretes. Rheology of fresh shotcrete.	
Rheology of self-compacting concrete	
Sample. System of particles. Skeletal structure. Dilatation. Spatial sample model. Stability of sample.	
Functional tie between spatial and rheological properties of concrete.	
Composition of research seminar paper.	

Rheology of Materials GAMT01 6.0	Associate Professor Sandra Juradin, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	NEW MATERIALS IN CIVIL ENGINEERING
Code	GAMT02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Associate Professor Sandra Juradin, PhD
Learning outcomes and competences	The student will be able: • select and recommend the composition of self-compacting concrete • select and recommend the composition of light concrete (regular and self-compacting) • select and recommend the composition of recycled material concrete • select and recommend the composition of concrete with high usability properties • select and recommend the composition materials • test properties, compare and recommend types of insulation materials
Recommended literature	(1) Ukrainczyk, V.: Beton: struktura, svojstva, tehnologija, ALCOR, Zagreb, 1994. (2) Bartos, P. J. M.: Special Concretes, workability and mixing, proceedings of the international RILEM workshop, Paisley, Scotland, 1993, (3) Balaguru, P.; Nanni, A.; Giancaspro, J.: FRP Composites for Reinforced and Pre-stressed Concrete Structures, Taylor & Francis, New York and London (4) MacElroy D.,L.; Kimpflen J.L.: Insulation, materials, testing and applications, ASTM Symposium on Insulation materials, Baltimore 1990.
Supplementary literature	(1) Maso, J.C.: Interfaces ina Cementitous Composites, LMDC, INA-UPS, Touluse, France 1992, (2) Feldman, D.: Polymeric building materials, (3) Clarke, J.L.: Structural Design of Polymer Composites, The European structural polymeric composites group (4) Gjørv E., Sakai, K.: Concrete Technology for a Sustainable Development in the 21st Century, E&FN Spon
Teaching methods	Lectures and seminars with the use of state-of-the-art devices (computer work), laboratory.
Assessment methods	Oral exam, Oral presentation of the seminar paper.

Teaching units	**Duration**
Technology, structure and properties of cement composites	4
Special concrete (micro-reinforced concrete with high usability properties, self-compacting, light concrete with high usability properties, recycled material concrete, eco-concrete)	4
Special concrete (smart concrete, shotcrete with high usability properties, injection mixtures, mortar, decorative concrete)	4
Composite polymer-based materials.	4
New types of reinforcement materials (micro fibres of different kind and origin, bearing reinforcement of different types and origin)	4
New types of glass as building material	4
Modern insulation materials (hydro-insulation, thermos-insulation)	4
Modern insulation materials (noise insulation)	2
Composition of research seminar paper.	60

New Materials in Civil Engineering GAMT02 6.0	Associate Professor Sandra Juradin, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	SYSTEM ENGINEERING IN PROJECT MANAGEMENT
Code	GALA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Snježana Knezić, PhD
Learning outcomes and competences	The student will be able to: • apply system analysis to system modelling, i.e. project management; • plan and manage projects by using models and techniques of system engineering; • optimise project processes, especially in conditions of limited resources; • apply models of operational research and expert systems in project management; • select and rank projects; • implement TQM in project management.
Recommended literature	(1) H. Kerzner: Project Management, a System Approach to Planning, scheduling and, VNR New York. (2) B.S. Blanchard: System Engineering Management, John Wiley & Sons. (3) S. Knezić: Autorizirani materijali s Lectures.
Supplementary literature	(1) L. Troncale: The system sciences: What are they? Are they one or many?, Invited Review, EJOR Vol. 31, No. 1. (2) S.E. Elmaghraby: Activity nets: A guided tour through some recent developments, Invited Review, EJOR Vol. 82, No. 3. (3) P. Brucker et al: Resource-constrained project scheduling: Notation, classification, models and methods, Invited Review, EJOR Vol. 112, No. 1
Teaching methods	Lectures. Problem-solving exercises with available software support. Independent composition of the seminar paper.
Assessment methods	Oral exam and oral presentation of the seminar paper.

Teaching units	**Duration**
Basics of system theory. System approach. Structured system analysis. Natural and managed (cybernetic) systems. Civil engineering project as system. Planning and management of civil engineering projects. System elements modelling. Models and techniques of system engineering. Operational research methods and their application in civil engineering project management. Project planning in conditions of limited resources. Selected models of linear programming, dynamic programming, game theory, and expert systems in project management. Mono-criteria and multi-criteria methods of project selection and ranking. Simulation systems in civil engineering project management. TQM project management. Software and systems for large-scale civil engineering projects management – integrated computer systems. New methods and trends in the project management. Examples from the civil engineering practice.	30

System Engineering in project Management GALA01 6.0	Prof. Snježana Knezić, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	DECISION SUPPORT SYSTEMS
Code	GALA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Nenad Mladineo, PhD / Assistant Professor Nikša Jajac, PhD
Learning outcomes and competences	The student will be able to: • connect the basic principles of decision-making theory with specific problem • select the most appropriate method of multi-criteria analysis • integrate certain system constituents for decision-making support • evaluate the efficiency of certain systems in civil engineering practice
Recommended literature	(1) P.G.W. Keen, M.S.C. Morton: Decison Support System: an Organisational Perspective, Addison-Wesley Publishing Company, 1978. (2) T.L. Saaty: The Analytic Hierarchy Process, McGraw Hill, New York, 1980. (3) J.P. Brans, B. Mareschal: The PROMCALC & GAIA Decision Suport System for Multicriteria Decision Aid, Vrije Universiteit Brussel, 1991. (4) G. DeSanctis, R.B. Gallupe:Foundation for Study of Group Support Systems, Management Science, Vol. 33, No. 5, 589-609. (5) E. Turban: Decision Support and Expert Systems (Management Support Systems), Macmillan Publishing Company New York, 1993. (6) S. Knezić: Autorizirani materijali s Lectures.
Supplementary literature	(1) T.L. Saaty: Group Decision Making and the AHP, 59-67, 1987. (2) J.P. Brans, C. Macharis, B. Mareschal: The GDSS PROMETHEE Procedure, Vrije universitet Brussel, 1997. (3) L.M. Jessup, J.S. Valacich: Group Support Systems: New Perspectives, Macmillan, 1992. (4) L. Troncale: The system sciences: What are they? Are they one or many?, Invited Review, EJOR Vol. 31, No. 1.
Teaching methods	Lectures. Problem-solving exercises with available software support. Independent composition of the paper.
Assessment methods	Oral exam, oral presentation of the paper.

Teaching units	**Duration**
Introduction to decision-making theory. Decision models. Decision support systems. Decision support systems concept. Structured, semi-structured and ill-structured problems. Group decision support systems. Data base management. Model management. User interface management. Information systems as parts of decision support systems. Multi-criteria decision making. Multi-criteria analysis methods (AHP, PROMETHEE, ELECTRE, etc.). Expert systems. Conceptual basis of expert systems. Knowledge base models (predicate calculus, frames, semantic networks, production systems, scripts, neural networks). Knowledge acquisition. Expert systems as parts of decision support systems. Strategy of decision support systems development. Software and application in the civil engineering practice.	30

Decision Support Systems GALA02 6.0	Prof. Nenad Mladineo, PhD / Assistant Professor Nikša Jajac, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	SYSTEM THEORY
Code	GALA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Snježana Knezić, PhD / Prof. Nenad Mladineo, PhD
Learning outcomes and competences	The student will be able to: • confirm the general system theory; • recognise and analyse system entropy; • analyse systems and propose improvements; • create organisational structure of cybernetic systems; • propose organisational solutions of automated system management.
Recommended literature	**(**1) L. von Bertalanffy, General System TheoryGeorge Braziller, bilo koje izdanje (2) General Systems Theory and Cybernetics, Springer Berlin / Heidelberg, Volume 216/2007 (3) Žugaj, M., J. Šehanović, M. Cingula: Organizacija, TIVA, Varaždin, 2004. (4) S. Knezić: Autorizirani materijali s Lectures.
Supplementary literature	(1) L. Troncale: The system sciences: What are they? Are they one or many?, Invited Review, EJOR Vol. 31, No. 1.
Teaching methods	Lectures. Problem-solving exercises with available software support. Independent composition of the paper.
Assessment methods	Oral exam and oral presentation of the seminar paper.

Teaching units	**Duration**
General system theory. Basic structure and characteristics of systems. System entropy. Models of open systems. System analysis. Lifecycle of systems. Linear and dynamic processes. Cybernetic systems. Basics of cybernetics. Regulation of systems' functioning. System management. Automated management.	30

System Theory GALA03 6.0	Prof. Snježana Knezić, PhD / Prof. Nenad Mladineo, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	HIGHWAYS AND THE ENVIRONMENT
Code	GAAA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Darovan Tušek, PhD
Learning outcomes and competences	The student will be able to: • analyse factors affecting the selected traffic solution, • assess the influences of the traffic intervention on the environment, • support conclusions on the assessment of environmental impact with appropriate regulations, • propose alternative traffic solution
Recommended literature	(1) Izbor iz zakonske regulative: Zakon o prostornom uređenju (NN 153/2013); Zakon o gradnji (NN 153/2013), Zakon o zaštiti okoliša (NN 80/2013, 153/2013)); Uredba o procjeni utjecaja zahvata na okoliš (NN 61/2014); (2) I.Lozić: Planning and Design of Roads in Protected Areas. 12th World Congress International Road Federation, Madrid, 1993. (3) S.Jurković: Promjene vizuelnih vrijednosti krajolika gradnjom infrastrukturnih trasa. Prostor, 1,1993.
Supplementary literature	
Teaching methods	Lectures; seminar paper.
Assessment methods	Defence of the seminar paper. Oral exam.

Teaching units	**Duration**
Integral concept of environmental protection. Main principles, documents and implementation of environmental protection. Environmental impact assessment; content of the environmental impact study. Analysis of potential environmental effects, measures for reducing the environmental threats and the programme for monitoring the state of the environment. Final evaluation of the study. Analysis of factors influencing the selection of the highway route: climate, geology, terrain, hydrology, archaeology, ecosystems and all other natural and man-made values: developmental, social, political and economic factors. Change of land use. Highway, railroad, airport and river structures. Emissions of harmful substances, noise, visual degradation of the environment. Presentation and analysis of already developed environmental impact studies for traffic - infrastructure interventions into the environment.	30

Highways and the Environment GAAA01 6.0	Prof. Darovan Tušek, PhD	**Lectures** • 30 hours **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper. **Exam** Oral. Oral presentation of the seminar paper. **Terms** By agreement.

Course title	INFORMATION ENGINEERING
Code	GATA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ante Munjiza, PhD
Learning outcomes and competences	The student will be able to: • differentiate between computer languages • develop a computer application describing an engineering process • assess the advantages of structured and object-oriented approach • design the graphic interface for the application • integrate the methods of team development, spatially distributed development, parallel and distributed computer science and intelligent engineering
Recommended literature	1) S. Robinson et al.: Professional C#. ISBN 1 86100704-3. 2) R. Winder: Developing Java Software, ISBN 13: 9780470090251. 3) T. Grandon: Introduction to Programming Using Visual C++.NET. ISBN 13: 9780471487241. 4) E. Koffman, P. Wolfgang: Objects,Abstraction, Data Structures and Design. ISBN 13: 97804171467557. 5) H Van Vliet: Software Engineering. ISBN 13: 9780471975083. 6) C. Horstmann: Object-Oriented Design and Pettern, ISBN 13: 9780471744870. 7) W. Emmerich: Engineering Distributed Objects, ISBN 13: 9780471986577. 8) A. Munjiza: The Combined Finite-Discrete Element Method, udžbenik, Wiley&Sons, London 2004.
Supplementary literature	Many papers in international journals at student`s selection.
Teaching methods	Lectures with the use of developmental programmes. Composition of independent seminar paper related to published scientific paper at student`s selection.
Assessment methods	Seminar paper and defence of seminar paper. Oral exam.

Teaching units	**Duration**
Introduction to computer languages	4
Design basics of engineering software	10
Object-oriented engineering software	6
Development of engineering software	6
Development of parallel engineering software	4
Composition of research seminar paper.	60

Information Engineering GATA02 6.0	A. Munjiza A. Munjiza	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	ENGINEERING SIMULATIONS TECHNIQUES
Code	GATA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Ante Munjiza, PhD
Learning outcomes and competences	The student will be able to: • integrate the formulation of finite rotations and deformities into the finite element method • formulate modern methods in engineering simulations • present scientific papers by the use of contemporary engineering notation • formulate processes of contact interaction and fragmentation in discreet systems
Recommended literature	(1) A.Munjiza, The Combined Finite-Discrete Element Method, udžbenik, Wiley&Sons, London 2004.; (2) A.Munjiza, Tensor Algebra in Science and Engineering, udžbenik, Ventus Publishing, 2010.; (3) A.Munjiza, Mechanics of Discontinua, udžbenik, Wiley&Sons, London 2010.; (4) A.Munjiza, Tailor made .pdf and .ppt notes.
Supplementary literature	Many papers in international journals at student`s selection.
Teaching methods	Lectures with the use of developmental programmes. Composition of independent seminar paper related to published scientific paper at student`s selection.
Assessment methods	Seminar paper and defence of seminar paper. Oral exam.

Teaching units	**Duration**
Tensor calculus	8
Basic engineering simulation techniques	6
Engineering simulations with the application of open source and commercial software	6
Presenting of scientific papers by the use of contemporary engineering notation	6
Generalisation of engineering simulation techniques on different systems (civil engineering, medicine, chemistry and mechanical engineering)	4
Composition of research seminar paper	60

Engineering Simulations Techniques GATA03 6.0	A. Munjiza A. Munjiza	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper. Oral exam. **Terms** By agreement

Course title	APPLIED FUNCTIONAL ANALYSIS
Code	GAMA01
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Assistant Professor Slavica Ivelić Bradanović, PhD
Learning outcomes and competences	The student will, through basic concepts and functional analysis theorems, be able to: • formulate some boundary-value problems in the form of variation equations; • determine the existence and uniqueness of weak solutions of given boundary-value problems • test the conditions of solving potential of linear algebraic and operation equations; • by applying the adequate algorithm, solve the task with limitations in the form of equality
Recommended literature	(1) J.N. Reddy, Applied Functional Analysis and Variational Methods in Engineering, McGraw-Hill Book Company, 1987; (2) I. Aganović, Uvod u rubne zadaće mehanike kontinuuma, Zagreb, 2003.
Supplementary literature	S. Kurepa, Funkcionalna analiza- elementi teorije operatora, Školska knjiga, Zagreb, 1980.
Teaching methods	Lectures and composition of the seminar paper.
Assessment methods	Oral exam, Oral presentation of the seminar paper.

Teaching units	**Duration**
GENERAL CONCEPTS AND FORMULATIONS Open, closed, convex, coupled set. Area, area boundary, Lipschitz`s boundary. Divergence theorem, gradient theorem.	3
OVERVIEW OF SOME EQUATIONS Description of motion. Material derivation. Continuity equation. Deformity and stress tensor. Newton`s fluid. Boundary-value problems with limitations in the form of equality and inequality.	7
FUNCTIONAL ANALYSIS TERMINOLOGY Theory of normed and inner product spaces (Banach and Hilbert spaces). Linear transformations and functionals. Linear transformations on finite-dimensional spaces. Linear, bilinear and quadratic forms. Linear functionals and operators on Hilbert spaces. Representation of the linear functional. Symmetric, positive and positive-definite operator. Sobolev functional space and the functional trace from that space. Inequalities (Friedrichs, Poincare). Variation (weak) boundary-value formulation. Weak solutions. Minimum of quadratic functional.	8
EXISTENCE AND UNIQUENESS OF SOLUTIONS Linear algebraic equations and solvability conditions. Linear operator equations and solvability conditions and Banach`s fixed point theorem. Regularity of solution for the variation boundary-value problem and Lax-Milgram theorem.	7
TASKS WITH LIMITATIONS IN THE FORM OF EQUALITY Introduction. Examples. Method of Lagrangian multipliers. Penalty method.	3
EIGENVALUES AND EIGENVECTORS Introduction. Existence and uniqueness.	2
Composition of research seminar paper.	60

Applied Functional Analysis GAMA01 6.0	S. Ivelić Bradanović S. Ivelić Bradanović	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper and knowledge of subject matter. Oral exam. **Terms** By agreement

Course title	PRACTICAL METHODS OF OPTIMISATION
Code	GAMA02
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Assistant Professor Jelena Sedlar, PhD
Learning outcomes and competences	The student will be able to: • assess if a practical problem can be formulated as mathematical optimisation problem, • establish if the formulated problem of mathematical optimisation belongs to the type of problem which can be reliably and efficiently solved by optimisation methods (least squares method, linear programming, convex optimisation) and provide substantiated arguments for his/her position, • select optimisation method for solving the formulated problem, • develop algorithms for solving moderate size problems by the selected optimisation method, • define the optimal solution, • assess performance constraints and elaborate his/her position.
Recommended literature	(1) S. Boyd, L. Vandenberghe, Convex Optimization, Cambridge University Press New York, New York, 2004; (2) M. Bazara, J. Jarvis, H. Sherali, Linear Programing and Network Flows, John Wiley & Sons, Inc., Hoboken, New Jersey, 2010; (3) S. Zlobec, J. Perić, Nelinearno programiranje, Naučna knjiga, Beograd, 1987.
Supplementary literature	F. L. Vasiljev, Čislenije metodi ekstremalnyh zadač, Nauka Moskva, 1988.
Teaching methods	Lectures, research seminar, consultations.
Assessment methods	Oral exam, oral presentation, rad.

Teaching units	**Duration**
Problem classification. Convex set, convex conus. Representation of the convex set. Convex function. Convex programming. Examples.	6
Linear programming. Minimum requirements for unconstrained problems.	4
Numerical methods: gradient method, Newton`s method, quasi-Newton method, conjugate gradient method etc.	6
Convex programming with constraints. Duality in convex optimisation. Kuhn-Tucker`s conditions.	4
Optimisation methods: Lagrangian method of multipliers, penalty method etc.	6
Other optimisation methods: dynamic programming, 0-1 search method, stochastic programming.	4
Composition of research seminar paper.	60

Practical Methods of Optimisation GAMA02 6.0	J. Sedlar J. Sedlar	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper and knowledge of the subject-matter. Oral exam. **Terms** By agreement

Course title	MATHEMATICAL ANALYSIS OF BOUNDARY-VALUE PROBLEMS
Code	GAMA03
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher . Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Božo Vrdoljak, PhD
Learning outcomes and competences	The student will be able to: • formulate partial differential equations for given physical problems • classified partial differential equations into linear, quasi-linear and non-linear, • assess if the formulated partial differential equation can be solved by analytical methods or select the appropriate method • assess if the formulated partial differential equation can be solved by numerical methods or select the appropriate method
Recommended literature	[1] I. Aganović i K. Veselić, Linearne diferencijalne jednadžbe, PMF, Zagreb, 1997. [2] T.A. Bick, Elementary Boundary-value Problems, Marcel Dekker, New York, 1993. [3] P.K. Kythe, P. Puri and M.R. Schaferkotter, Partial Diferential Equations and Boundary-value Problems with Mathematica, Chapman & Hall/CRC, Boca Raton, 2003.
Supplementary literature	[1] M.A. Pinsky, Partial Differential Equations and Boundary-Value Problems with Applications, McGraw-Hill, Boston, 1998. [2] K. Yosida, Lectures on Differential and Integral Equations, Dover Publications, New York, 1991.
Teaching methods	Lectures, research seminar, consultations.
Assessment methods	Oral exam, Oral presentation of the seminar paper.

Teaching units	**Duration**
Equilibrium of stretched string and membrane, oscillation and diffusion problems, equilibrium and constitutive laws. Modelling for wave, diffusion and potential equations. Types of conditions and problems, initial and boundary-value problem, Dirichlet and Neumann problem, classification of second-order partial differential equations. Method of characteristics for first and second-order equations, transformation of equations to normal form. Equilibrium of stretched string, Green function. Contact field and equilibrium of stretched membrane, Laplace equation, Green formula. Fundamental solutions, Green function, harmonic functions. Dirichlet and Neumann problem for circle and ball, spherical and cylindrical functions. Diffusion equation in thermodynamics, maximum principle, Poisson formula. Wave equation, Kirchoff and Poison formula. Method of separation of variables, Green method. Calculus of variations, variation problems for functions of one or several variables, variation problems with higher derivatives and with several unknown functions, Euler differential equation in calculus of variations. Variation formulation of boundary-value problems. Numerical solution of boundary-value problems, method of finite differences, method of collocation and least square method, variation methods, Galjerkin method, Rayleigh-Ritz method, finite element method.	30

Mathematical Analysis of Boundary-Value Problems GAMA03 6.0	B. Vrdoljak	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper and knowledge of the subject-matter. Oral exam. **Terms** By agreement

Course title	INTEGRAL EQUATIONS
Code	GAMA04
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Božo Vrdoljak, PhD
Learning outcomes and competences	The student will be able to: • formulate integral equations for solving initial and boundary problems of regular and partial equations • classify integral equation and select appropriate solving method • determine if integral transformations are applicable • determine if numerical methods are applicable
Recommended literature	[1] H. Hochstadt, Integral Equations, J, Wiley, 1994. [2] K. Yosida, Lectures on Differential and Integral Equations, Dover Publications, New York, 1991.
Supplementary literature	[1] I. Aganović i K. veselić, Linearne diferencijalne jednadžbe, PMF, Zagreb, 1997. [2] T.A. Bick, Elementary Boundary-value Problems, Marcel Dekker, New York, 1993.
Teaching methods	Lectures, research seminar, consultations.
Assessment methods	Oral exam, oral presentation of the seminar paper.

Teaching units	**Duration**
Definition and classification, Fredholm and Volterra integral equations, relation to differential equations. Fredholm integral equations, equations with degenerate kernels, discussion on solutions, eigenvalues and eigenfunctions, transposed integral equation, method of successive approximations, Neumann series. Fredholm method, Fretholm theorems. Solution of homogeneous integral equation, orthonormal systems for given kernel, iterative procedure. Volterra integral equations, solution by differentiating, method of successive approximations, Neumann series, Volterra integral equations of convolution type. Singular integral equations, Abel equation, equation with Cauchy kernel. Hilbert-Schmidt theory of integral equations with symmetric kernels, eigenvalues and eigenfunctions, Hilbert-Schmidt theorem. Integral equations which transform to equations with Hermite kernel. Banach fixed point theorem and existence of solution of integral equations Integral transformations: Laplace, Fourier and Hankel, inverse transformations, properties, applications in solving initial and boundary value problems for ordinary and partial differential equations. Numerical solution of integral equations, approximation of integral, approximation of kernel, collocation method, quadrature formula, variation methods, collocation method, least square method and Galjerkin method.	30

Integral Equations GAMA04 6.0	B. Vrdoljak	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper and knowledge of the subject-matter. Oral exam. **Terms** By agreement

Course title	METHODS OF MATHEMATICAL STATISTICS
Code	GAMA05
ECTS (number of allocated credits)	6.0 Number of ECTS credits was calculated according to the assessment of the course teacher. Lectures (30 hours) = 0.8 ECTS; Independent work and study (97 hours) = 3.2 ECTS; Composition of research seminar paper (60 hours) = 2.0 ECTS
Teachers and/or associates	Prof. Božo Vrdoljak, PhD
Learning outcomes and competences	The student will be able to: • formulate stochastic model of practical problems with emphasis on water management • select statistical method or test for model evaluation • assess gained results of the formed stochastic model • assess constraints of the selected model
Recommended literature	[1] B. Vrdoljak, Vjerojatnost i statistika, Građevinsko-arhitektonski fakultet, Split, 2006. [2] Ž. Pauše, Uvod u matematičku statistiku, Školska knjiga, Zagreb, 1993. [3] J.D. Salas, J.W. Delleur, V. Yevjevich and W.L. Lane, Applied Modeling of Hidrologic Time Series, Water Resources Publications, Michigan, 1980.
Supplementary literature	[1] I. Pavlić, Statistička teorija i primjena, Tehnička knjiga, Zagreb, 1977. [2] M. Ilijašević i Ž. Pauše, Riješeni primjeri i zadaci iz vjerojatnosti i statistike, "Zagreb", Zagreb, 1990.
Teaching methods	Lectures, research seminar, consultations.
Assessment methods	Oral exam, oral presentation of the seminar paper.

Teaching units	**Duration**
Random events, random variables. Distributions of random variables: Normal or Gauss, lognormal, gamma, log-Pirson 3, chi-square, Gumbel, student t-distribution, Fisher F-distribution. Distribution function. Random vectors, independence of random variables, moments, correlation coefficient, regression. Statistical decision, estimation of parameters, sample mean, sample variance, sample range, sample correlation coefficient. Method of maximum likelihood, method of moments, distribution of parameter estimators. Some statistical distributions, confidence intervals for unknown parameters of distribution, confidence intervals for distribution function. Hypothesis testing, hypothesis tests for distribution. Example of applications of statistics in hydrology: Coincidence tests of empirical and theoretic distributions in hydrology, chi-square test, Kolmogorov-Smirnov test. Analysis of homogeneity of hydrological series. Testing of mean, student t-test. Testing of variance of two samples. Independence analysis of hydrological series, test for squares of differences. Sample regression and correlation, least square method, Gauss-Markov theorem, analysis of data dispersion, testing of hypothesis on regression coefficient, generating series by linear regression model, auto-correlation. Independence analysis of time series components, linearly dependent stationary processes. Nonlinear regression. Multiple correlation and regression.	30

Methods of Mathematical Statistics GAMA05 6.0	B. Vrdoljak	**Lectures** • 30 hours-15 weeks equally distributed or blocks of lectures • use of blackboard, PP presentation and computer classrooms **Research seminar paper** • 60 hours Literature, consultations and exam can be carried out in English	**Seminars** One seminar paper based on overview of literature and scientific papers from the selected topic area. **Exam** Oral presentation of the seminar paper and the knowledge of subject-matter. Oral exam. **Terms** By agreement

2. Teachers` and supervisors` papers in CROSBI and Scopus

Supervisors and teachers (name and surname/ institution)	**Research or (scientific-teaching) title and election area/field**	**Papers in CROSBI http://bib.irb.hr/ (MZB = registration number of the teacher)**	**Papers in Scopus https://www.scopus.com/ (Scopus ID = researcher`s identification number in Scopus)**
Roko Andričević / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 223606	Scopus ID 6603873452
Ivica Boko / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 220730	Scopus ID 16243258000
Ognjen Bonacci / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Professor Emeritus in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 4434	Scopus ID 7003625022
Deana Breški / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 220741	Scopus ID 16506403600

Vladimir Cvetković / The Royal Institute of Technology (KTH), Department of Civil and Environmental Engineering, Division of Water Resources Engineering Stockholm, Sweden	Professor at the Department of Civil and Environmental Engineering, Division of Water Resources Engineering	---	Scopus ID 7004494711
Dražen Cvitanić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 220752	Scopus ID 56625132500
Vesna Denić-Jukić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 196750	Scopus ID 7801666138
Mirela Galić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 220774	Scopus ID 8654866700
Blaž Gotovac / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 14020	Scopus ID 6602441620
Hrvoje Gotovac / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 244885	Scopus ID 22934117200

Alen Harapin / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 189684	Scopus ID 6507587901
Adnan Ibrahimbegović / Universite de Technologie de Compiegne, Laboratoire Roberval de Mécanique (CNRS UMR7337), Compiegne, France	Professor Classe Exceptionnelle Subject Area: Computational Mechanics; Solid & Structural Mechanics	---	Scopus ID 7005029864
Slavica Ivelić Bradanović / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Assistant Professor in the scientific area of Natural Sciences, scientific field of Mathematics	CROSBI MBZ 265526	Scopus ID-1 36095651600 Scopus ID-2 57035430700
Nikša Jajac / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Assistant Professor in the interdisciplinary scientific area, scientific field of Project Management (elective fields of Civil Engineering and Economics)	CROSBI MBZ 265473	Scopus ID 16063957700
Vinko Jović / University of Split, Faculty of Civil Engineering, Architecture and Geodesy retired since 01/10/2015	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 19014	Scopus ID-1 7005514696 Scopus ID-2 7005514901

Damir Jukić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 199705	Scopus ID 56235065900
Sandra Juradin / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 203911	Scopus ID 6506134192
Snježana Knezić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Fundamental technical Sciences	CROSBI MBZ 163740	Scopus ID-1 6505831577 Scopus ID-2 6602195212
Vedrana Kozulić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 176112	Scopus ID 7801669505
Nenad Leder / Croatian Hydrographic Institute, Split – external associate	Assistant Professor in the scientific area of Natural Sciences, scientific field of Physics	CROSBI MBZ 192292	Scopus ID 6603057265
Jure Margeta / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 70755	Scopus ID 6603947261
Pavao Marović / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 70744	Scopus ID 6505967180

Domagoj Matešan / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 237143	Scopus ID 7801383890
Ante Mihanović / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 30725	Scopus ID-1 6602936023 Scopus ID-2 55912423800
Predrag Miščević / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 137614	Scopus ID 6507321194
Nenad Mladineo / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor, first election into the u scientific area of Technical Sciences, scientific field of Fundamental technical Sciences	CROSBI MBZ 70823	Scopus ID 6602363699
Ante Munjiza / Queen Mary, University of London, School of Engineering and Materials Science, London, United Kingdom	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 121890	Scopus ID 15748619900
Željana Nikolić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering and scientific field of Other Fundamental Technical Sciences	CROSBI MBZ 176101	Scopus ID 7006320511

Bernardin Peroš / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 36305	Scopus ID-1 6506157972 Scopus ID-2 56780054700
Jure Radnić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 70834	Scopus ID 6602638002
Tanja Roje-Bonacci / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Full Professor with tenure in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 41435	Scopus ID 6508259880
Jelena Sedlar / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Assistant Professor in the scientific area of Natural Sciences, scientific field of Mathematics	CROSBI MBZ 244896	Scopus ID 8261290400
Veljko Srzić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Assistant Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 301583	
Neno Torić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Assistant Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 291876	Scopus ID 35732701500
Boris Trogrlić / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 210964	Scopus ID 23973949100

Mijo Vranješ / University of Split, Faculty of Civil Engineering, Architecture and Geodesy	Associate Professor in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 53172	Scopus ID 6505952170
Božo Vrdoljak / University of Split, Faculty of Civil Engineering, Architecture and Geodesy – external associate	Full Professor with tenure in the scientific area of Natural Sciences, scientific field of Mathematics	CROSBI MBZ 53341	---
Ivan Vrkljan / Institut IGH d.d., Zagreb	Professor Emeritus in the scientific area of Technical Sciences, scientific field of Civil Engineering	CROSBI MBZ 93393	Scopus ID 6507161052