NAME OF THE COURSE	**COMPUTATIONAL METHODS IN WATER RESOURCES AND ENVIRONMENTAL ENGINEERING**					
Code		Year of study	1, I.semester			
Course teacher	Hrvoje Gotovac, PhD, Assistant Professor	Credits (ECTS)	5.0			
Associate teachers		Type of instruction (number of hours)	L	S	E	F
			30		15	
Status of the course	Compulsory	Percentage of application of e-learning	0%			
COURSE DESCRIPTION						
Course objectives	According to the labor market needs, the objectives of the course is to introduce basic theorethical and practical principles of computational methods in water resources and environmental engineering.					
Course enrolment requirements and entry competences required for the course	Undergraduate qualification (6th level of EQF or CROQF) in the technical or natural sciences.					
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The student will: • Define, analyze and solve large sparse (non) linear system of equations, • Define, analyze and use Fourier spectral analysis, • Define, analyze and solve initial value problem of ODE - Ordinary Differential Equations, • Define, analyze and solve boundary-initial value problem for all basic types of elliptic, parabolic and hiperbolic problems, • Define, analyze and solve basic optimization problems, • Define, analyze and solve basic random processes, • Define and use appropriate stochastic and/or numerical model using suitable computational techniques • Learn state of tha art numerical and stochastic models in MATLAB					
Course content broken down in detail by weekly class schedule (syllabus)	Linear Algebra: Direct and iterative methods. Iterative solving of large sparse linear system of equations; Krylov subspace methods; Preconditioning. Conjugate gradients for symmetric matrices, GMRES for non-symmetric matrices. Solving of nonlinear equations; Newton method. Transformations: Orthogonal sets of functions, Fourier series, Dirichlet theorem, series expansions and approximations of functions. Fourier spectral analysis. Fourier and Laplace transform. Initial value problem: Ordinary differential equations. Initial conditions. Explicit Runge-Kutta and Adams methods. Stability analysis. Implicit methods. Accuracy. Examples of free and forced oscillations. Boundary-initial value problem: Ordinary and partial differential equations; Initial and boundary conditions (Dirichlet, Neumann and Cauchy types). Eigenvalue boundary value problems, Sturm-Liouville problem, Collocation method, Least square method and Galerkin method. Finite difference method and finite element method; example of Laplace equation. Method of lines: spatial and temporal discretization. Stability criteria: Peclet and Courant numbers, numerical oscillations and dispersion. Accuracy. Adaptive methods. Wave and convection-diffusion equation. Optimization: Minimization of functions of variables that are either unconstrained, subject to equality and inequality constraints. Includes methods for linear and nonlinear programming. Random Processes and applications: Review of basic probability and the					

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<tr><td></td><td colspan="6">formulation, analysis, representation, and application of some standard random processes. Basic concepts of random processes, random processes in linear systems, expansions of random processes, Wiener filtering, spectral representation of random processes, and white-noise integrals.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐seminars and workshops
☒ exercises
☐on line in entirety
☐partial e-learning
☐field work</td><td colspan="3">☐ independent assignments
☐multimedia
☐laboratory
☐work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Preparation of an assignment.</td></tr>
<tr><td rowspan="5">Screening student work(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1.0</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1.0</td><td></td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td>2.0</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1.0</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Three written assignments (40%), seminar (10%), final examination – oral (50%).</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">A. Quarteroni, R. Sacco, F. Saleri; Numerical Mathematics, Springer-Verlag, 2000.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">(1) D. G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press, 2011
(2) Y.Saad, Iterative methods for sparse linear systems, SIAM, 2003;</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">Quality assurance will be performed at three levels:
(1) University level, through questionnaires; (2) Faculty level by Quality Control Committee; (3) Lecturer's level.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
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