COURSE DESCRIPTION CARD

Faculty of Civil Engineering and Environmental Sciences		
Field of study		**Degree level and programme type**	
Specialization/ diploma path	-	**Study profile**	**Academic profile**
Course name	**Computational methods**	**Course code**	**IS-FCEE-00182S**
		Course type	**Erasmus**

Forms and number of hours of tuition	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**summer**
	15				30			**No. of ECTS credits**	**3**

Entry requirements	**Mathematics I, Basics of computer science, Theoretical mechanics**
Course objectives	Acquiring the abilities of: numerical solution of systems of linear equations and nonlinear equations, numerical integration and differentiation and numerical solution of initial value problems for ordinary differential equations of first and second order. Understanding of theoretical basis of methods of approximation and interpolation. Acquainting students with selected computer programs for numerical and symbolic solution, and computer programs for modelling simple engineering structures and conducting static analysis.
Course content	**L:** The specificity of computer calculations in construction. Errors in numerical calculations. Elementary use of series and approximate expressions. Iterative methods for nonlinear equations. Direct and iterative methods for solving linear systems of equations. Eigenvalues and eigenvectors of matrices. Interpolation, approximation and extrapolation. Numerical integration and differentiation. The initial value problems for ordinary differential equations (first and second order). **SW:** Numerical calculations using *MS Excel* software (iterative methods for nonlinear equations; direct and iterative methods for solving linear systems of equations, eigenvalues and eigenvectors of matrices; approximation, interpolation and extrapolation; integration and differentiation; first and second order ordinary differential equations). Numeric and symbolic calculation using *Mathcad* and *SMath Studio* software (nonlinear equations; linear systems of equations, integration and differentiation; first and second order ordinary differential equations). Modelling of engineering structures and determination of internal forces and displacements in simple structural systems.
Teaching methods	multimedia presentation, computer software for numerical and symbolic calculation, engineering software for static analysis of building structures.
Assessment method	Lecture & specialization workshop – minimum five tests (or test online)

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**

LO1	Student has knowledge in the field of numerical methods used to find the exact and approximate solutions of systems of linear equations and approximate solutions of nonlinear equations. The student is also versed in the methods of differentiation and numerical integration and numerical methods used to approximate solving of the initial value problems for first- and second-order ordinary differential equations.	K_W01, K_W12
LO2	Student has a basic knowledge in the field of interpolation and approximation methods.	K_W01, K_W12
LO3	Student solves non-linear equations by iterative methods and systems of linear equations by direct and iterative methods.	K_U14
LO4	Student can calculate approximating and interpolating polynomials.	K_U14
LO5	Student can use numerical methods for integration and differentiation as well as for solving selected initial problems for first- and second-order ordinary differential equations.	K_U14
LO6	Student uses at least one computer program for numerical and symbolic calculation.	K_U10, K_U11, K_U14
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	Written test from lecture (or test online)	L
LO2	Written test from lecture (or test online)	L
LO3	Verification of student work during classes in a specialization workshop. Verification of practical skills in the form of a test using for this purpose the necessary computer software.	SW
LO4	Verification of student work during classes in a specialization workshop. Verification of practical skills in the form of a test using for this purpose the necessary computer software.	SW
LO5	Verification of student work during classes in a specialization workshop. Verification of practical skills in the form of a test using for this purpose the necessary computer software.	SW
LO6	Verification of student work during classes in a specialization workshop. Verification of practical skills in the form of a test using for this purpose the necessary computer software.	SW

Student workload (in hours)		**No. of hours**
Calculation	lecture attendance	**15**
	participation in classes, laboratory classes, etc.	**30**
	preparation for classes, laboratory classes, projects, seminars, etc.	**20**
	working on projects, reports, etc.	**-**
	participation in student-teacher sessions related to the classes/seminar/project	**5**
	implementation of project tasks	**-**
	preparation for and participation in exams/tests	**15**
	TOTAL:	**85**

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	50	2
Student workload – practical activities	85	3
Basic references	1. Chapra St., Canale R.: Numerical Methods for Engineers. 7-th edition. McGraw-Hill Education. New York, 2015.		
Supplementary references	1. Granville Sewell: Computational Methods of Linear Algebra. Second edition. A John Wiley&Sons Publication, Hoboken, New Jersey, 2005. 2. Obsieger B.: Numerical methods I. Basis and fundamentals. University Books.EU. 2013. 3. Ralston A., Rabinowitz P.: A First Course in Numerical Analysis: Second Edition. Dover, 2001. 4. Hildebrand F. B.: Introduction to Numerical Analysis: Second Edition. Reprint of the McGraw-Hill Book Co., New York, Courier Corporation, 2013.		
Organisational unit conducting the course	**Department of Geotechnics and Structural Mechanics**	**Date of issuing the programme**	
Author of the programme	**Krzysztof Robert Czech, PhD Eng.**	**2021.04.08**	

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar