COURSE DESCRIPTION CARD

<table>
<tr><td colspan="10">Faculty of Electrical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="6">Electrical and Electronics Engineering</td><td>Degree level and programme type</td><td>Masters's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="6">-</td><td>Study profile</td><td>-</td></tr>
<tr><td rowspan="2">Course name</td><td colspan="6" rowspan="2">Numerical methods in Electrical Engineering: Selected issues</td><td>Course code</td><td>IS-FEE-20012W</td></tr>
<tr><td>Course type</td><td>elective</td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter</td></tr>
<tr><td>15</td><td></td><td></td><td></td><td>15</td><td></td><td></td><td>No. of ECTS credits</td><td>2</td></tr>
<tr><td>Entry requirements</td><td colspan="9">-</td></tr>
<tr><td>Course objectives</td><td colspan="9">To acquaint students with chosen numerical methods of solving electrical problems (i.e. electric circuits, electromagnetic phenomena), particularly with algorithms and available applications for the solution of differential equations which correspond to steady state and transient behaviour. To show students how to: (a) use and implement some of the methods to solve problems connected with electrical engineering; (b) use some mathematical and specialized software; (c) assess reliability of numerical results; (d) validate and interpret results of implemented algorithms.</td></tr>
<tr><td>Course content</td><td colspan="9">Lecture: Mathematical modelling and computer aided solution of EE problems: the aims and classification of the methods. Taylor's series and its interpretation, Taylor's theorem for functions of many variables. Differential approximation of linear and vector operators used in electrical problems. The formulation and properties of the finite difference method (incl. finite difference time domain method). Finite element method. Principles of distributed processing. Paradigms of multi-processing. Coefficients of performance, Amdahl's law, Gustaffson's law, the properties and implementation of distributed processing libraries.
Specialization workshop: Numerical analysis of chosen circuit and field problems related to electrical engineering with the use of the finite difference and finite element methods. Declaration of boundary conditions, analysis of chosen open boundary problems. Analysis and validation of results.</td></tr>
<tr><td>Teaching methods</td><td colspan="9">Student can use the common numerical software to solve problems described by differential equations</td></tr>
<tr><td>Assessment method</td><td colspan="9">Lecture - final written test (at least 50% of points are necessary to pass).
Workshop - written reports and tests.</td></tr>
<tr><td>Symbol of learning outcome</td><td colspan="8">Learning outcomes</td><td>Reference to the learning outcomes for the field of study</td></tr>
<tr><td>LO1</td><td colspan="8">can make use of common numerical software to solve problems described by differential equations</td><td></td></tr>
<tr><td>LO2</td><td colspan="8">understands and knows how to implement a finite difference scheme and a finite element algorithm</td><td></td></tr>
<tr><td>LO3</td><td colspan="8">is able to interpret and assess the results of computations</td><td></td></tr>
<tr><td>LO4</td><td colspan="8">understands the principles of distributed processing, its properties and</td><td></td></tr>
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	constraints		
LO5	understands and explains the principles of computer aided modelling, including typical numerical methods and their implementation		
Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**	
LO1	evaluation of students' reports and written tests	**SW**	
LO2	test, evaluation of students' reports	**L, SW**	
LO3	evaluation of students' reports and written tests	**SW**	
LO4	test, evaluation of students' reports and written tests	**L, SW**	
LO5	test	**L**	
Student workload (in hours)		**No. of hours**	
Calculation	Lecture attendance:	**15**	
	Preparation for workshops:	**8**	
	Participation in workshops:	**15**	
	Work on reports from workshop classes and/or work on home assignments	**10**	
	Participation in student-teacher sessions related to lectures and workshops:	**4**	
	Preparation for and attendance at the final test from lectures:	**8**	
	TOTAL:	**60**	
Quantitative indicators		**HOURS**	**No. of ECTS credits**
Student workload – activities that require direct teacher participation		**34**	**0**
Student workload – practical activities		**45**	**0**
Basic references	1. Gilat A., Subramaniam V., Numerical methods for engineers and scientists : an introduction with applications using MATLAB, John Wiley & Sons, Hoboken, 2011. 2. Elsherbeni A.Z., Demir V., The finite-difference time-domain method for electromagnetics with MATLAB simulations, SciTech Publishing, Raleigh, 2009. 3. Butcher J.C., Numerical methods for ordinary differential equations, J. Wiley & Sons, 2003. 4. Evans G., Blackledge J., Yardley P., Numerical methods for PDE, Springer, 2000. 5. William H.P., Numerical recipes: the art of scientific computing, Cambridge Univ. Press, 2007.		
Supplementary references	Hager G., Wellein G.: Introduction to high performance computing for scientists and engineers. CRC/Taylor & Francis, Boca Raton, 2011. Schafer M.: Computational engineering : introduction to numerical methods. Springer-Verlag, Berlin, 2006. Mathews J.H., Fink K.D., Numerical methods using MATLAB, Pearson Education, 2004. Rosłoniec S., Numerical methods in electrical engineering, Springer, Berlin, 2006.		
Organisational unit conducting the course	**Department of Electrotechnics, Power Electronics and Power Engineering**	**Date of issuing the programme**	
Author of the programme	**Boguslaw Butrylo, D.Sc., Ph.D., Assoc. Prof.**	**2020-02-13**	

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