Załącznik nr 6 do ZW 121/2020

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish: Matematyka stosowana
Name of subject in English: **Applied Mathematics**
Main field of study (if applicable): Power Engineering
Specialization (if applicable):
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: W09ENG-SM0034
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15	15		
Number of hours of total student workload (CNPS)	60	30	30		
Form of crediting	Examination	Crediting with grade	Crediting with grade		
For group of courses mark final course with (X)					
Number of ECTS points	2	1	1		
including number of ECTS points for practical (P) classes		1	1		
including number of ECTS points for direct teacher-student contact (BU) classes	1	0.75	0.75		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of calculus, linear algebra and information technology as taught at the first level of studies

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SUBJECT OBJECTIVES

C1 Presenting the mathematical tools necessary for an engineer to understand the mathematical description of physical phenomena occurring in devices and technical processes related to broadly understood power engineering, including linear and non-linear algebraic equations as well as ordinary and partial differential equations.

C2 Presentation of practical methods for solving the above equations, using both accurate and approximate methods, including a wide range of available software.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 understands how the physical aspect of processes occurring in technology is described mathematically in the form of algebraic and differential equations

PEU_W02 in relation to a mathematical problem (e.g. an algebraic or differential equation), distinguishes between its exact and approximate solution and understands the relationship between them; knows methods suitable for determining accurate or approximate solutions, using direct calculations or appropriate software

relating to skills:
PEU_U01 knows how to indicate equations (algebraic or differential) describing physical phenomena in the studied technical processes
PEU_U02 for an identified mathematical problem, knows how to choose proper tools leading to its solution
PEU_U03 knows how to perform calculations using a suitable calculation tool, assess its accuracy and interpret the physical and technical significance of the results obtained

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Symbolic and numerical calculations. Examples of ordinary differential equations (ODE).	2
Lec 2	Methods for solving first and second order equations (ODE).	2
Lec 3	Physical motivation for ODE equations.	2
Lec 4	Existence and uniqueness of solutions. Initial and boundary conditions.	2
Lec 5	Discretization of a differential equation. Algebraic equations.	2
Lec 6	Programming in C ++ and Pascal: code examples.	2
Lec 7	Accurate and approximate methods for solving systems of linear equations.	2
Lec 8	Methods for solving systems of nonlinear equations.	2
Lec 9	Examples of partial differential equations (PDEs). Types of equations. Initial conditions and boundary conditions.	2
Lec 10	Vector analysis. Stokes integral theorem.	2
Lec 11	Selected equations of mathematical physics (Fourier, Navier-Stokes and others).	2
Lec 12	Laplace and Poisson equation.	2
Lec 13	Fourier series and their application to differential equations.	2
Lec 14	Discretization of partial equations. Finite difference method. CFD.	2
Lec 15	Ansys, Comsol, OpenFoam: examples of applications.	2
	Total hours	30

Classes		Number of hours
Cl 1	Solving first and second order scalar equations (ODE).	4
Cl 2	Calculation of Laplace transforms and applications to ODE.	2
Cl 3	Finding Fourier series and applications to the Fourier equation.	2
Cl 4	Application of the series method to flow in a pipe.	2
Cl 5	Examples of first and second order PDEs	2
Cl 6	Discretization of the Navier-Stokes equation for a two-dimensional cavity.	1
Cl 7	Written test	2
	Total hours	15

Laboratory		Number of hours
Lab 1	Symbolic and numerical calculations (Matlab, Sage, Mathematica).	1

Lab 2	Numerical calculations in C ++ or Pascal.	1
Lab 3	Large systems of linear equations.	2
Lab 4	Scalar nonlinear equations.	1
Lab 5	Systems of nonlinear equations.	1
Lab 6	First order initial problems (ODE).	2
Lab 7	Second order initial problems and boundary problems (ODE).	1
Lab 8	Partial initial-boundary problems (PDE).	1
Lab 9	Unsteady one-dimensional heat flow.	2
Lab 10	Selected 2D laminar fluid flows.	3
	Total hours	15

TEACHING TOOLS USED

N1. Lecture using multimedia (presentation - slides)
N2. Computational exercises on the blackboard, supported by software.
N3. Computer laboratory using symbolic and numerical calculations software and a programmer's environment for creating numerical programs.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P	PEU_W01-PEU_W02	written exam
P	PEU_U01-PEU_U03	test at the end of the classes
P	PEU_U01-PEU_U03	laboratory reports

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] J. Mathews, K. Fink: Numerical Methods Using MATLAB, Pearson Education 2004.
[2] W. Cheney, D. Kincaid: Numerical Mathematics and Computing, Thomson Brooks 2008.
[3] M. Abell, J. Braselton: Differential Equations with Mathematica, Elsevier 2004.

SECONDARY LITERATURE:

[1] G. Dahlquist, A. Bjorck: Numerical Methods in Scientific Computing, SIAM 2007.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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