FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish: Podstawy programowania
Name of subject in English: Fundamentals of Programming
Main field of study (if applicable): Power Engineering
Specialization (if applicable): Computer Aided Mechanical and Power Engineering
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: optional/specialization
Subject code: W09ENG-SM0053
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		*
For group of courses mark final course with (X)					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BU) classes	1		1.5		

*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 a selected programming environment and showing how to use it in order to obtain a numerical code implementing selected calculation algorithms.
C2 Presentation of sample algorithms implementing selected calculation goals met typically while using mathematical tools in engineer practice, especially during numerical modelling of physical phenomena, such as heat flow or fluid flow.
C3 Developing practical skills leading from identifying a computational problem through selection of algorithms and programming tools, creating code, running the program, up to verifying the correctness and accuracy of the numerical results obtained.

SUBJECT LEARNING OUTCOMES

relating to knowledge:
PEU_W01 understands how the computer performs numerical calculations and knows principles of numerical programming
PEU_W02 knows the basic algorithms that solve typical computational tasks occurring when mathematical tools are applied to engineering problems

relating to skills:

PEU_U01 knows how to use a selected developer environment
PEU_U02 can decide whether a given computational problem can be solved by computer; if so, is able to select the appropriate numerical algorithm as well as programming tools suitable for coding this algorithm; subsequently, is able to run correctly and efficiently the code and obtain the desired numerical results

PROGRAM CONTENT

	Lectures	**Number of hours**
Lec 1	Operating systems, programs, programming languages. Constants, variables, types, operators.	2
Lec 2	Program flow control. Calculations using integer and real numbers.	2
Lec 3	Functions and procedures. Processor, registers, RAM and disk memory.	2
Lec 4	Loops and logical conditions applied to calculating series, derivatives, integrals.	2
Lec 5	First and second order ordinary differential equations.	2
Lec 6	File operations. Output and graphic presentation of results.	2
Lec 7	One-dimensional steady heat flow. Internal heat sources.	2
Lec 8	Accurate solutions of linear equation systems.	2
Lec 9	The role of programming in numerical solution of differential equations of mathematical physics and numerical modelling of physical processes,	2
Lec 10	Relaxation methods of solving systems of linear equations.	2
Lec 11	Transient heat flow problem.	2
Lec 12	Fluid flows - physical foundations, mathematical description, algorithms.	2
Lec 13	Fluid flow in a two-dimensional cavity (lid-driven cavity problem).	2
Lec 14	Programming in Ansys and OpenFoam. Parallel programming. Using graphics cards for numerical calculations.	2
Lec 15	Written test.	2
	Total hours	30

	Laboratory	**Number of hours**
Lab 1	Installation of a programming environment. Compilation of a simple program.	2
Lab 2	Calculations with integers and reals. Ranges of values, precision, text formats of real numbers.	2
Lab 3	Calculating series, derivatives and integrals.	2
Lab 4	Functions and procedures.	2
Lab 5	Examples of numerical algorithms implementation for ordinary differential equations.	3
Lab 6	File operations. Output of results. Graphical presentation of results.	2
Lab 7	One-dimensional fixed heat flow. Internal heat sources.	3
Lab 8	Accurate solution of linear equation systems. Cramer patterns. Gauss elimination. Thomas' algorithm.	4

Lab 9	Relaxation methods for solving systems of linear equations. Jacobi method. Gauss-Seidel method.	4
Lab 10	Transient heat flow.	3
Lab 11	Numerical solution for selected two-dimensional fluid flows.	3
	Total hours	30

TEACHING TOOLS USED

N1. Lecture using multimedia (presentation - slides), supported by numerical software.
N3. Computer laboratory using programmer's environment for creating numerical programs.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), C – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F	PEU_W01- PEU_W02	Written test
F	PEU_U01- PEU_U02	Laboratory reports

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] T. Beu: Introduction to Numerical Programming, CRC Press, 2015.
[2] D. Yevick: A Short Course in Computational Science and Engineering - C ++ , Java and Octave Numerical Programming with Free Software Tools.
[3] W. Cheney, D. Kincaid: Numerical Mathematics and Computing, Thomson Brooks 2008.
[4] G. Dahlquist, A. Bjorck: Numerical Methods in Scientific Computing, SIAM 2007.

SECONDARY LITERATURE:

[1] D. Haskins: C Programming in Linux.
[2] P. Wellin: Programming with Mathematica.

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

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*delete if not necessary