COURSE SYLLABUS

Course name in Polish	Obliczenia symboliczne w modelowaniu i symulacji
Course name in English	Symbolic Computations for Modelling and Simulation
Course type	directional
ISCED code	0613
Field of study	Computer Modelling in Mechanics
Language of instruction	English
Level of qualification	First cycle
Form of study	Full-time studies
ECTS points	4
Semester	2

Total number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Other
15	0	45	0	0	0

COURSE DESCRIPTION

COURSE OBJECTIVE

O1. Mastery by students of fundamental principles of symbolic computation and their applications in engineering modeling and simulation.

O2. Acquisition by students of practical skills in using tools for symbolic computation to solve engineering problems.

O3. Development by students of skills necessary for independently using symbolic computations.

PREREQUISITES IN TERMS OF KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of linear algebra, mathematical analysis, and basic differential equations.
2. Basic programming skills, with preferred experience in Python.
3. Ability to work independently.
4. Ability to think logically and solve problems.

LEARNING OUTCOMES

LO 1 – The student knows fundamental concepts and methods of symbolic computation and understands their application in engineering modeling and simulation.

LO 2 – The student can use symbolic computation tools to solve engineering problems.

LO 3 – The student can independently apply symbolic computations.

COURSE CONTENT

Course type – LECTURES	**Number of hours**
L1-2 – Introduction to symbolic computations.	2
L3-5 – Symbolic operations and expression manipulation.	3
L6-8 – Solving algebraic equations.	3
L9-11 – Differentiation and integration.	3
L12-14 – Equation generation and applications.	3
L15– Final assessment in written form – colloquium /test.	1

Course type – LABORATORY	**Number of hours**
Lab1-3 – Introduction to SymPy and working environment.	3
Lab4-6 – Manipulation of symbolic expressions.	3
Lab7-12 – Solving algebraic equations.	6
Lab13-18 – Symbolic differentiation and integration.	6
Lab19-24 – Ordinary differential equations.	6
Lab25-30 – Equation generation and analysis.	6
Lab31-36 – Applications of symbolic computations in simulation.	6
Lab37-42– Summary and final project.	6
Lab43-45 – Final assessment – colloquium.	3

TEACHING TOOLS

1. Lecture supported by multimedia presentations, lecture materials.
2. Computer laboratory equipped with dedicated software, instructions for laboratory exercises.

METHODS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

F01 – Completion of laboratory exercise.
F02 – Participation in discussion (activity during classes).
P01 – Colloquium.*
P02 – Colloquium.*

*) a prerequisite for receiving credit is to receive positive grades on all of the above listed items.

STUDENT WORKLOAD

Ref No.	Form of activity	Average number of hours to complete the activity
1. Contact hours		
1.1	Lectures	15
1.2	Tutorials	
1.3	Laboratories	45
1.4	Seminars	
1.5	Project	
1.6	Office hours	
1.7	Exam	
	Total contact hours:	60
2. Self-study hours		
2.1	Preparation for tutorials and the final test	
2.2	Laboratory preparation, laboratory report preparation	20
2.3	Project preparation	
2.4	Preparation for the final lecture test	10
2.5	Exam preparation	
2.6	Literature review	10
	Total self-study hours:	40
	Total student workload:	100
TOTAL NUMBER OF ECTS POINTS FOR THE COURSE		4
Number of **ECTS** points which a student obtains in classes requiring direct teacher participation:		2.4

Number of **ECTS** points that a student obtains in practical classes, including laboratory and project classes:	2.6

PRIMARY AND SUPPLEMENTARY RESOURCES

1. Harris FE. Mathematics for physical science and engineering: symbolic computing applications in Maple and Mathematica. Academic Press; 2014.
2. Pagonis V, Kulp CW. Mathematical Methods using Python: Applications in Physics and Engineering. CRC Press; 2024.
3. Meurer A, Smith CP, Paprocki M, Čertík O, Kirpichev SB, Rocklin M, Kumar A, Ivanov S, Moore JK, Singh S, Rathnayake T. SymPy: symbolic computing in Python. PeerJ Computer Science. 2017

COURSE COORDINATOR (NAME, SURNAME, DEPARTMENT, E-MAIL)

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MATRIX OF LEARNING OUTCOMES

Learning outcome	Reference of the given outcome to outcomes defined for the entire program (CLO)	Course objectives	Course content	Teaching tools	Method of assessment
LO 1	K_W01, K_W10	O1	L1-15	1-2	P02
LO 2	K_U01, K_U10	O2	Lab1-45	1-2	F01-02, P01

LO 3	K_K01	O3	Lab1-45	1-2	F01-02, P01

FORMS OF ASSESSMENT– DETAILS*

Learning outcomes	Grade 2.0	Grade 3.0	Grade 4.0	Grade 5.0
LO 1	The student does not know the basic concepts and methods of symbolic computations and does not understand their application in engineering modeling and simulation, scoring < 50% on the final assessment.	The student partially understands the basic concepts and methods of symbolic computations but does not fully understand their applications, scoring 50 – 65% on the assessment.	The student understands the basic concepts and methods of symbolic computations and their applications in engineering modeling and simulation, scoring 70 – 85% on the assessment.	The student thoroughly understands the basic concepts and methods of symbolic computations, their applications in engineering, and demonstrates the ability to independently deepen their knowledge, scoring 95 – 100% on the assessment.
LO 2	The student cannot use symbolic computation tools to solve engineering problems, did not	The student demonstrates limited ability to use symbolic computation tools to solve engineering	The student can use symbolic computation tools to solve engineering problems; the results of	The student uses symbolic computation tools with precision and efficiency to solve

	complete laboratory exercises, or the results are incorrect, scoring < 50% on the final assessment.	problems; the results of laboratory exercises are partially correct, scoring 50 – 65% on the assessment.	laboratory exercises are correct, scoring 70 – 85% on the assessment.	engineering problems; laboratory exercises are performed with great care, achieving correct results, scoring 95 – 100% on the assessment.
LO 3	The student cannot independently use symbolic computations, does not complete laboratory exercises, and fails to demonstrate an understanding of the tools.	The student demonstrates limited independence in using symbolic computations, completes laboratory exercises with assistance, and shows partial understanding of the tools.	The student independently uses symbolic computations, completing laboratory exercises accurately and demonstrating a solid understanding of the tools.	The student fully independently uses symbolic computations, completing laboratory exercises with high precision and demonstrating deep understanding of the tools and the ability to interpret the obtained results.

* A half grade of 3.5 is given if the student has achieved the learning outcomes for a grade of 3.0 but has not fully completed the learning outcomes for a grade of 4.0 .A half grade of 4.5 is given if the student has achieved the learning outcomes for a grade of 4.0, but the student has not fully completed the learning outcomes for a grade of 5.0.

OTHER USEFUL COURSE INFORMATION

1. Course topics, resources and literature are provided in classes, in the teacher's office, and in the USOS system.
2. Information on office hours is provided to students during the first class of a given course, and is also placed on website - www.wim.pcz.pl