Course Syllabus

I. General Information

Course name	Introduction to mathematical modelling
Programme	Mathematics
Level of studies (BA, BSc, MA, MSc, long-cycle MA)	BA
Form of studies (full-time, part-time)	Full-time studies
Discipline	Mathematics
Language of instruction	English

Course coordinator/person responsible	Prof. dr hab. Piotr Matus

Type of class *(use only the types mentioned below)*	Number of teaching hours	Semester	ECTS Points
lecture	30	III	5
tutorial			
classes	30	III	
laboratory classes			
workshops			
seminar			
introductory seminar			
foreign language classes			
practical placement			
field work			
diploma laboratory			
translation classes			
study visit			

Course pre-requisites	Knowledge of basic subjects from the study program: Mathematical analysis

II. Course Objectives

C1. Presentation of main concepts and basic methods of mathematical modeling.
C2. Presentation of difference schemes used for solving tasks which exact solutions are difficult to find or impossible to determine analytically

III. Course learning outcomes with reference to programme learning outcomes

Symbol	Description of course learning outcome	Reference to programme learning outcome
KNOWLEDGE		
W_01	Students are familiar with basic concepts of mathematical modeling	K_W01, K_W04
W_02	Students are able to recognize typical problems that can be described using mathematical modeling	K_W01, K_W04
SKILLS		
U_01	Students are able to present correct mathematical reasoning, formulate theorems and definitions	K_U38
U_02	Students recognize problems, including practical issues, which can be solved by mathematical modeling	K_U38
SOCIAL COMPETENCIES		
K_01	Students are aware of the level of their knowledge and skills in mathematical modeling; students understand the need of further training and improving both professional and personal competence	K_K02, K_K05

IV. Course Content

1) Method of mathematical modeling
2) Typical problems of mathematical physics
3) Fundamental concepts of the theory of difference schemes
(grids and grids function, difference approximation of derivates)
4) Error of approximation of a difference scheme
5) Canonical form of a difference scheme
6) Notation of a difference scheme in the matrix-vector form
7) Thomas algorithm
8) Left elimination method and opposite elimination method
9) Stability of difference schemes
10) Maximum principle
11) Convergence of difference schemes
12) Difference schemes for equation with variable coefficients
13) Difference schemes for the transfer equation
14) Difference schemes for the heat conduction equation
15) Method of energy inequalities
16) Difference schemes for the hyperbolic equation of the second order
17) Non-uniform grids
18) Difference schemes for heat conduction equation with variable coefficients
19) Stability of difference schemes for wave equation
20) Calculation of shock waves

V. Didactic methods used and forms of assessment of learning outcomes

Symbol	Didactic methods *(choose from the list)*	Forms of assessment *(choose from the list)*	Documentation type *(choose from the list)*
	KNOWLEDGE		
W_01	Conventional lecture, Guided practice	Exam / Oral test	Protocol
W_02	Conventional lecture, Guided practice,	Exam / Oral test	Protocol
	SKILLS		
U_01	Practical classes	Exam / Oral test Test (oral or written)	Protocol Evaluated test
U_02	Practical classes	Exam / Oral test Test (oral or written)	Protocol Evaluated test
	SOCIAL COMPETENCIES		
K_01	Discussion	Exam / Oral test	Protocol

VI. Grading criteria, weighting factors.....

Attendance at the classes is required.
Passing classes - test
Exam: oral test - for people who passed the classes.

Less than 50% fail
Detailed assessment rules are given to students with each subject edition

VII. Student workload

Form of activity	Number of hours
Number of contact hours (with the teacher)	90
Number of hours of individual student work	60

VIII. Literature

Basic literature
1. M. Głowacki; Modelowanie matematyczne i symulacje komputerowe odkształcania metali, Wydawnictwo AGH, Kraków 2012 2. S. Lemeshevsky, P. Matus, D. Poliakov; Exact finite-differene schemes,De Gruyter, 2016.
Additional literature