STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Numerical methods	**1010342621010340026**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mathematics	**general academic**	**1 / 2**

Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Modelling in applied sciences	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **30**	Classes: **-**	Laboratory: **30**	Project/seminars: **-**		**6**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**100 100%**
Technical sciences	**100 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	The student has an extended and in-depth knowledge of: * Mathematics (in terms of material studies grade 1, and the initial and boundary value problems for ordinary and partial differential equations) * Numerical methods (in terms of material studies grade 1) * Computer Science (programming in high level language).
2	**Skills**	The student is able to solve math problems in material studies degree 1. The student is able to implement the algorithm in high-level programming. Student uses at least one commercial computer package for solving the basic numerical methods.
3	**Social competencies**	The student is aware of the validity of the effects of mathematical calculations. The student understands the need for learning.

Assumptions and objectives of the course:

Learning advanced numerical methods and apply them to solve complex mathematical and engineering problems. Supporting math and engineering relevant IT tools.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student is able to choose and apply numerical methods for solving mathematical tasks formulated in technical issues - [K_W07, K_W10]
2. The student knows advanced computational techniques to support the work the math and understand their limitations - [K_W08, K_W11]

Skills:

1. The student is able to choose and apply appropriate computational methods to solve mathematical tasks formulated in other fields of science - [K_U10, K_U16]
2. can correctly construct numerical algorithms for solving complex mathematical problems - [K_U19, K_U20]
3. The student is able to carry out measurements and tests computer complex mathematical problems, interpret the results and draw conclusions - [K_U16, K_U20]

Social competencies:

1. The student understands the necessity of systematic work on complex projects - [K_K03]
2. The student knows the limitations of their knowledge and understands the need for further education - [K_K01]
3. The student can independently search for information in the literature - [K_K06]

Assessment methods of study outcomes

Lecture

* Assessment of the knowledge and skills demonstrated during the problematic character of exam,
* Control of perception during lectures.

Laboratory exercises:

* Tests and rewarding knowledge necessary to perform laboratory tasks.
* Continuous assessment, for each course - rewarding gain skills they met the principles and methods
* Assess the knowledge and skills related to the implementation of the tasks of exercises, evaluation reports performed exercise,
* Assessment of teamwork skills.

Recovery points for additional activity in the classroom, and in particular for:

* Propose to discuss additional aspects of the subject;
* The effectiveness of the application of acquired knowledge when solving a given problem;
* Comments relating to the improvement of teaching materials;
* Aesthetic diligence reports and jobs - in the framework of self-study.

Course description

Initial-value problems for ordinary differential equations:
(Higher-order equations and systems of differential equations).
Boundary value problems for ordinary differential equations.
Numerical differentiation of functions of several variables.
Boundary and initial-boundary value problems for partial differential equations - difference methods.
Numerical solutions of nonlinear systems of equations.
Update 2017:
Applied methods of education:
Lectures:
Lecture with multimedia presentation (including: drawings, photos) supplemented by examples given on the board,
Lecture conducted in an interactive way of formulating questions to a group of students or indicated specific students,
Student activity is taken into account during the course of the assessment,
The initiating of discussion during the lecture,
Theory presented in connection with practice,
Theory presented in connection with the current knowledge of students,
Taking into consideration various aspects of the presented issues,
Presenting a new topic preceded by a reminder of related content known to students from other subjects;
Laboratories:
Laboratories supplemented with multimedia presentations (including drawings, photos)
Detailed review of the reports by the teacher and discussion of the comments,
Demonstrations,
Work in teams,
Computational experiments;

Basic bibliography:

1. Kincaid, Cheney, Analiza numeryczna, WNT, Warszawa,
2. Burden, Faires, Numerical analysis, Prindle, Weber and Schmidt, Boston,
3. Kącki, Równania różniczkowe cząstkowe w zagadnieniach fizyki i techniki, WNT, Warszawa

Additional bibliography:

1. Zarowski, An introduction to numerical analysis for electrical and computer engineers, Wiley

2. Rosłoniec, Wybrane metody numeryczne z przykładami zastosowań w zadaniach inżynierskich, Oficyna Wydawnicza Politechniki Warszawskiej,

3. B. Szyszka, An Interval Version of Cauchy?s Problem for the Wave Equation, AIP Conference Proceedings 1648, s. 800006-1 ? 800006-4, 2015 AIP Publishing LLC,

4. Marciniak A., Szyszka B., A Central-Backward Difference Interval Method for Solving the Wave Equation, Lecture Notes in Computer Science, LNCS Volume 7782, s. 518-527, Springer-Verlag Berlin, Heidelberg 2013,

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in laboratory classes	30
3. Participation in consultations	10
4. implementation and verification the programs (time outside of the classroom laboratory)	8
5. preparation for laboratory classes	8
6. Preparing to pass laboratories	12
7. familiarization with the indicated literature and teaching materials	20
8. final exam preparation and participation in the final exam	20

Student's workload

Source of workload	hours	ECTS
Total workload	138	6
Contact hours	73	3
Practical activities	63	3