Appendix No. 1.5 to the Resolution No.61/2025
of the Rector of the University of Rzeszów

SYLLABUS

REGARDING THE QUALIFICATION CYCLE FROM 2026 TO 2029
ACADEMIC YEAR 2028/2029

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	Introduction to Numerical Methods
Course/Module code *	
Faculty (name of the unit offering the field of study)	Faculty of Exact and Technical Sciences
Name of the unit running the course	Institute of Mathematics
Field of study	Mathematics
Qualification level	First-cycle studies (Bachelor's)
Profile	General academic
Study mode	Full-time
Year and semester of studies	Year 3, Semester 5
Course type	Major subject
Language of instruction	English
Coordinator	Mirosława Zima, PhD, DSc
Course instructor	Mirosława Zima, PhD, DSc

* - according to the arrangements in the Unit

1.1.Learning format – number of hours and ECTS credits

Semester (no.)	Lectures	Classes	Laboratories	Seminars	Practical classes	Internships	others	**ECTS credits**
5	30		30					5

1.2. Course delivery methods

☒ conducted in a traditional way
☐ involving distance education methods and techniques

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)
Laboratories – pass with a grade, lecture – pass without a grade

2. PREREQUISITES

Knowledge of differential and integral calculus of a function of one variable, elements of linear algebra and elements of programming.

3. OBJECTIVES, LEARNING OUTCOMES, COURSE CONTENT, AND INSTRUCTIONAL METHODS

3.1. Course/Module objectives

C1	Familiarization students with elements of error theory, with basic methods of interpolation and approximation of functions.
C2	Providing knowledge in the field of numerical solving of nonlinear equations. Familiarization with basic methods of numerical integration.
C3	Familiarization with selected numerical algorithms of linear algebra.
C4	Preparing students to use numerical software.
C5	Preparing students for teamwork.

3.2. COURSE/MODULE LEARNING OUTCOMES (TO BE COMPLETED BY THE COORDINATOR)

Learning Outcome	**The description of the learning outcome defined for the course/module**	**Relation to the degree programme outcomes**
LO_01	The student knows the basic numerical methods and procedures supporting the solving of problems in the field of mathematical analysis and algebra.	K_W05
LO_02	The student knows the basic occupational health and safety rules of computer operation.	K_W08

Learning Outcome	The description of the learning outcome defined for the course/module	Relation to the degree programme outcomes
LO_03	The student is able to use numerical methods to solve selected problems from mathematical analysis and algebra.	K_U11
LO_04	The student is ready for continuous learning and improving their qualifications related to the use of numerical methods of mathematical analysis and algebra.	K_K01
LO_05	The student is ready to ask questions to understand numerical methods used in solving mathematical problems.	K_K02
LO_06	The student is ready to seek advice from experts in the field of numerical methods and programming regarding the use of the latest knowledge in professional work.	K_K03

3.3. Course content (to be completed by the coordinator)

A. Lectures

Content outline
Error analysis (concept of error, types of errors, data representation error, arithmetic error, error propagation, perturbation analysis).
Calculating polynomial values (Horner's scheme).
Function interpolation (interpolation problem, polynomial interpolation, Lagrange interpolating polynomial, Newton's form of the interpolating polynomial, Hermite interpolation, estimation of the interpolation error, spline interpolation). Localization of polynomial zeros (Sturm's method, Fourier's method).

Nonlinear equations (iterative methods, bisection method, Newton's method, secant method).
Numerical integration (Newton-Cotes quadratures, Gauss quadratures).
Numerical methods of linear algebra (LU decomposition and its applications, Gaussian elimination method, iterative methods - Jacobi method, Seidel method).
Function approximation (approximation problem, orthogonal polynomials, discrete mean-square approximation).

B. Classes, laboratories, seminars, practical classes

Content outline
Error analysis (concept of error, types of errors, data representation error, arithmetic error, error propagation, perturbation analysis).
Calculating polynomial values (Horner's scheme).
Function interpolation (interpolation problem, polynomial interpolation, Lagrange interpolating polynomial, Newton's form of the interpolating polynomial, Hermite interpolation, estimation of the interpolation error, spline interpolation). Localization of polynomial zeros (Sturm's method, Fourier's method).
Nonlinear equations (iterative methods, bisection method, Newton's method, secant method).
Numerical integration (Newton-Cotes quadratures, Gauss quadratures).
Numerical methods of linear algebra (LU decomposition and its applications, Gaussian elimination method, iterative methods - Jacobi method, Seidel method).
Function approximation (approximation problem, orthogonal polynomials, discrete mean-square approximation).

3.4. Methods of Instruction

Lecture: *a problem-solving lecture/a lecture supported by a multimedia presentation/ distance learning*

Laboratory exercises*: Group work, problem-solving, designing and analyzing simple numerical procedures*

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

Learning outcome	Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes)	Learning format (lectures, classes,…)
LO-01	test, quiz, observation during classes	lecture, laboratory
LO-02	observation during classes	laboratory
LO-03	test, quiz	lecture, laboratory
LO-04	test, quiz, observation during classes	lecture, laboratory
LO-05	observation during classes	lecture, laboratory
LO-06	observation during classes	lecture, laboratory

4.2 Conditions for passing the course (assessment criteria)

The basis for obtaining a pass from laboratory exercises is a positive grade from tests and activity during classes. The condition for passing the exercises is scoring at least 50% of points from each test. The final grade is then determined according to the scale:
below 50% pts. – fail
[50 – 60%) pts. – satisfactory
[60 – 70%) pts. – satisfactory plus
[70 – 80%) pts. – good
[80 – 90%) pts. – good plus
[90– 100%] pts. – very good.
Activity during exercises can raise the grade by half a degree.

The condition for passing the lecture is a positive grade from a quiz conducted on one of the lectures in the last month of classes of semester V. Below 40% correct answers means failing.

5. Total student workload needed to achieve the intended learning outcomes – number of hours and ECTS credits

Activity	Number of hours
Activity	60
Course hours	10
Other contact hours involving the teacher (consultation hours, examinations)	60
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	130
Total number of hours	5

* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

number of hours	not applicable
rules and forms of completing apprenticeships	not applicable

7. Instructional materials

Compulsory literaturę: 1. D. Kincaid, W. Cheney, Numerical analysis. Mathematics of scientific computing, Brooks/Cole Publishing Co., Pacific Grove, CA, 1996. 2. J. Stoer, R. Bulirsch, Introduction to numerical analysis, Text Appl. Math. 12, Springer-Verlag, New York, 2002.
Complementary literaturę: 1. R. Z. Morawski, A. Miękina, Introduction to Numerical Methods with 245 Solved Problems, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2025. 2. A. Ralston, P. Rabinowitz, A First Course in Numerical Analysis, Dover Publ. , New York 2001.

Approved by the Head of the Department or an authorised person