COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical Analysis and Statistics [S2IŚrod2>MNiS]

Course

Field of study
Environmental Engineering

Year/Semester
1/1

Area of study (specialization)
Water Supply, Water and Soil Protection

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Student knows - within the scope embraced by the mathematical training at the undergraduate level - the concepts in matrix algebra, in differential and integral calculus, and in differential equations Student is aware of the importance of mathematics in the description of scientific and engineering problems and understands the need for learning and improving mathematical skills by themself

Course objective

1) to familiarize students with the terminology and methods for the numerical solution of mathematical problems and statistical description of phenomena, 2) to show the specificity of numerical calculations and that of statistical elaborations, 3) show the area where the above applies.

Course-related learning outcomes

Knowledge:
1. student knows basic concepts in numerical analysis and basic numerical methods
2. student knows basic concepts in descriptive and mathematical statistics
3. student has a broader and deeper mathematical knowledge which is appropriate for issues found in environmental engineering

4. student knows basic methods, techniques, tools and materials which are necessary to treat complex engineering tasks.

Skills:
1. a critical evaluation of the results obtained in theoretical considerations and in calculations, including these produced by computers
2. the ability to find information in the literature and in the Internet

Social competences:
1. student is aware of the importance of mathematics in the description of scientific and engineering problems
2. student understands the need in continuous education
3. student understands the importance of precision, especially when (s)he is involved in any co-operation

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by passing the lecture determined by a set of exam topics.
The knowledge used to perform laboratory exercises is monitored on an ongoing basis using reports, while the skills acquired during the laboratories are tested in the final colloquium.

Programme content

NUMERICAL METHODS
Fixed- and floating-point arithmetics.
Numerical solution of nonlinear equations.
Polynomial interpolation.
Mean square approximation.
Numerical integration.
Numerical solution of differential equations.
STATISTICS
Random sample and its statistical description.
Random variable and its characteristics.
Basic statistical stepwise distributions.
Basic continuous statistical distributions.

Course topics

Numerical methods (lecture)
1) Decimal and binary numbers. Fixed- and floating-point entries.
2) Stability, conditioning, correctness and efficiency of the account.
3) Numerical solving of algebraic equations (methods: half-line, secants, tangents, fixed point).
4) Numerical solution of systems of linear and nonlinear algebraic equations.
5) Polynomial interpolation (Lagrange, Newton).
6) Mean square approximation of a set of points and functions.
7) Numerical differentiation and integration: trapezoidal and Simpson's formulas, ordinary and complex.
8) Numerical solution of ordinary differential equations: Euler's explicit and implicit methods and RK4 patterns.
Statistics (lecture)
1) Random sample and its statistical description.
2) Correlation coefficients.
3) Classical, geometric probability. Kolmogorov axiomatic probability.
4) Random variable and its characteristics (density, distribution function, expected value, deviation standard; moment generating function). Random variable functions (linear combination, power, exposure).
5) Basic step statistical distributions (uniform, binomial, geometric, Poisson, normal).

6) Basic continuous statistical distributions.

Numercal methods and statistics (laboratories)
Introduction to Matlab.
Stability, conditioning, correctness and efficiency of numerical calculations.
Polynomial interpolation (Lagrange, Newton).
Mean square approximation of a set of points and functions.
Numerical solution of algebraic equations (methods: half-line, tangents).
Numerical integration: trapezoidal and Simpson's formulas, simple and complex.
Numerical solution of ordinary differential equations: Euler and RK4 methods.
Random variable and its characteristics (density, distribution function, expected value, standard deviation, moments).
Basic statistical distributions (uniform, binomial, geometric, Poisson, normal).

Teaching methods

Lecture with multimedia presentation, supplemented by examples given on the board, taking into consideration students' current knowledge.
Laboratory classes with usage of computers with appropriate software and multimedia presentation.

Bibliography

Basic:
1. Z.Fortuna, B.Macukow, J.Wąsowski, Metody numeryczne, WNT
2. M.Liskowski, Podstawy statystyki praktycznej, WSHiG Poznań 2003

Additional:
1. A.Bjorck, G.Dahlquist, Metody numeryczne, PWN 1987
2. G.I.Marczuk, Modelowanie matematyczne problemów środowiska naturalnego, PWN 1985

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00