Course title: Mathematical methods in climatology

Form of teaching: lecture – 52 hrs., 5p. ECTS; practices – 52 hrs., 10 p. ECTS, total – 104 hrs., 15p. ECTS
Course completion requirements: lecture – final exam; practices – final test, project evaluation, evaluation of activity
Language of instructions: English

1. Short description, objectives:

Objective of the course is to provide fundamental concepts and methods in mathematical and statistical analysis necessary for description of atmospheric processes and phenomena.

2. Prerequisities:

1. reading and writing in English,

3. Learning outcomes

W03 - possess a knowledge about mathematics necessary for understanding phenomena and processes ongoing in the atmosphere (14K-1A_W03, 14K-1A_W05)
W06 - possess a knowledge about statistics necessary for description and understanding phenomena and processes ongoing in the atmosphere (14K-1A_W07)
W07 - possess a knowledge about basic technics and research tools used in meteorology and climatology (14K-1A_W05, 14K-1A_W07)
U01 – is able to use basic technics and research tools in meteorology and climatology (14K-1A_U01, 14K-1A_U02)
U05 –uses basic statistical technics for description of phenomena and data analysis (14K-1A_U03, 14K-1A_U05)
U07 – is able to formulate justified judgements basing on data from different (14K-1A_U07)
K01 – is able to cooperate in the group, taking over different roles (14K-1A_K01; 14K-1A_K02)
K03 – is able to define priorities designed for realisation of specific aim (14K-1A_K05)

4. Course description:

1) *Linear algebra and vector calculus.* Matrices, systems of linear equations, inverses, determinants. Vector spaces, orthonormal bases and orthogonal projections, eigen-values and eigen-vectors; diagonalisation
2) *Differential and integral calculus.* Fundamental concepts and methods in mathematical analysis, functions, limits, continuity, derivatives, integration, infinite series, Taylor expansion, partial derivatives; multiple integrals, curvilinear integrals, surface and volume integrals; integral calculus theorems.
3) *Probability theory and statistics*. Population and samples; frequency distributions; statistical descriptors and sample moments; elementary probability theory; conditional probability; independence; random variables and distributions; moments; two-dimensional distributions; marginal and conditional distributions; statistical hypotheses; error types; significance levels; tests of significance: univariate and multivariate time series; correlation. covariance, regression, relationship variables.

5. Cource evaluation

Final exam (W03, W06, K03) – 50% total score, (Exam can be taken by individuals who have passed practices),
the finale test for practices (U01, U05, K03) – 30% total score,
projects evaluation (U01, U05, U07, K01) – 10% total score,
evaluation of activity (U01, U05, U07, K02) – 10% total score.

6. Teaching methods

Teaching methods: lecture, multimedia presentations, discussion, work with the source material (book, article), practical exercises single handed and in the team, auditorium.

7. Recommended reading list

[1]. Wilks D.S., 2006, Statistical methods in the atmospheric sciences, Elsevier Academic Press Publications, 649 p.
[2]. Rayner J.N., 1997, Dynamic Climatology, basis in Mathematics and Physics, Blackwell Publishers, p. 279 p.