MSc programme in Environmental Meteorology and Climate Physics (LM-17 R)

Syllabus of the basic preparation required by candidates for successful attendance of the programme

Mathematics

- Numbers: Basic properties of natural, rational and real numbers and of the operation defined on them.
- Series: properties of series, criteria for convergence.
- Basic algebra: polynomials and operations defined on them, notable products, Ruffini's rule;
- Geometry: fundamentals of plane and solid geometry, formulae for calculating surface areas of regular plane figures and surface area and volume of the main regular solid figures, properties of angles defined by two parallel and a secant line.
- Trigonometry: trigonometric functions (sin, cos, tan, cotan) and their properties, operations with trigonometric functions, Carnot theorem, inverse trigonometric functions (arcsin, arccos, arctan, arccotan).
- Differential and integral calculus: properties of the most common functions (powers, polynomials, rational functions, exp, log, trigonometric functions, fractions), limits, derivatives and integrals of the basic functions, finding maxima and minima, Taylor series expansion;
- Vectors and matrices: vector properties, bases, unite vectors, eigenvalues and eigenvectors of a matrix, calculations and transformations using complex numbers and vectors based on an understanding of the fundamental concepts and methods associated with matrices, vectors and complex numbers;
- Fourier series: properties of trigonometric series, Fourier series expansion of periodic functions, calculation of coefficients
- Differential equations: Perform algebraic manipulation on basic first- and second-order ordinary differential and partial differential equations, including use of Fourier series and verification of solutions, and identify initial-value and boundary-value problems;
- Statistics: Select suitable ways of displaying statistical data, calculate basic statistical indicators such as mean, standard deviation and test of significance.

Physics

- Mechanics: basic concepts of the mechanics of a material point: positon, velocity, acceleration. Galileo's and Newton's laws of motion. Static equilibrium. Conservation of momentum and angular momentum. Conservation of energy. Rotating systems;
- Heat transfer: Explain the physical basis of heat transfer via conduction, convection and radiation;
- Basic thermodynamics: fundamentals properties of gaseous systems, including the gas laws for dry and moist air, first and second laws of thermodynamics, Dalton's Law and the kinetic theory

of gases, specific heat, latent heat, vapor pressure and saturation, reversible and irreversible processes, entropy and enthalpy, changes of phase;
- Waves: Explain the fundamentals of wave motion, including the concepts of reflection, refraction and diffraction, phase and group velocities, wave dispersion and wave breaking;
- Optics: reflection, refraction, diffraction and scattering of light;
- Electromagnetisms: properties of electric and magnetic field, electromagnetic waves, electromagnetic spectrum, black body radiation, Planck's Law, Wien's Law and Stefan-Boltzmann Law, and scattering, absorption and emission of radiation.

Chemistry
Period table of the elements. Main properties of the groups and periods. Main properties of the single elements. Stoichiometric balance of reactions. Chemical equilibria. Acids and bases and their reactions. Salts. Nomenclature. Fundamentals of organic chemistry.