

## SCIENTIFIC SUBJECT : NUMERICAL ANALYSIS AND SCIENTIFIC COMPUTING

The scientific subject “**Numerical Analysis and Scientific Computing**”, from the registry of scientific subjects of the Department of Statistics and Actuarial-Financial Mathematics of the School of Sciences of the University of the Aegean, focuses on the theoretical analysis, development, and application of efficient numerical methods and computational algorithms for approximating solutions to mathematical problems that arise in the physical sciences, engineering, and modern mathematical finance.

From the perspective of Numerical Analysis, the subject covers the theoretical foundation of numerical methods, including error analysis, convergence speed, and the stability of algorithms. Emphasis is placed on understanding the limitations and investigating the possibilities for extending and optimizing state-of-the-art numerical methods.

From the perspective of Scientific Computing, the subject explores the practical implementation of numerical methods, utilizing advanced computational environments and programming languages. It examines techniques for the efficient solution of complex and large-scale problems, such as the simulation of systems described by differential, partial differential, or integro-differential equations in high dimensions.

Particular importance is given to the development and use of modern computational techniques, such as:

- (1) **Mathematical Machine Learning:** This includes Physics-Informed Neural Networks (PINNs) for solving differential equations, designing mathematical models from data, and accelerating scientific computations.
- (2) **Advanced Optimization Algorithms:** The development and application of deterministic and stochastic optimization algorithms for large-scale problems in numerical analysis, statistics, financial mathematics, and machine learning.
- (3) **High-Performance Computing:** Utilization of parallel architectures and algorithms to tackle computationally demanding simulations and the analysis of large volumes of data.

The scientific subject covers courses with mathematical and programming content at the undergraduate and postgraduate levels, and focuses on specialized courses in numerical analysis, numerical solutions of ordinary, partial, and stochastic differential equations, as well as courses in machine learning.