

## Introduction

Engineers are constantly confronted with concrete problems in their respective fields. The majority of these problems can be formulated as mathematical problems (such as solving an equation, calculating an integral, and so on), and the majority of these problems are not resolvable by traditional analytical methods, or we are convinced that it will take a long time to solve them analytically if this is not possible, that is why we then resort to numerical methods.

For example the integrals  $\int_{-2}^3 e^{-x^2} dx$  and  $\int_{-\pi}^{\pi} \sin(x^2) dx$  cannot be calculated using classical methods such as integration by parts, substitution, etc.. Using a numerical method, this type of integration can be approximated numerically with a given accuracy.

Over the past few decades, numerous algorithms based on theoretical studies have been developed to solve various mathematical problems. This course is designed for second-year students of Material science. It constitutes an introduction to numerical calculation and consequently to the different techniques that these students will frequently have to use, without delving into the theoretical considerations and foundations of the methods presented. Indeed, we have described the most well-known and widely used numerical methods for solving various problems encountered during their studies, focusing on the practical aspects in the presentation of these methods.

In this booklet, each section is followed by detailed examples, and at the end of each chapter, students are encouraged to work on additional exercises. The course is structured into five main chapters : The first chapter is dedicated to numerical integration. The second chapter covers two methods of polynomial interpolation. The third chapter focuses on the numerical solution of nonlinear equations. The fourth chapter describes numerical techniques for solving ordinary differential equations. Finally, the last chapter is dedicated to methods for solving systems of linear equations.