ENGINEERING MATHEMATICS AND SCIENTIFIC COMPUTING with SymPy, NumPy and SciPy

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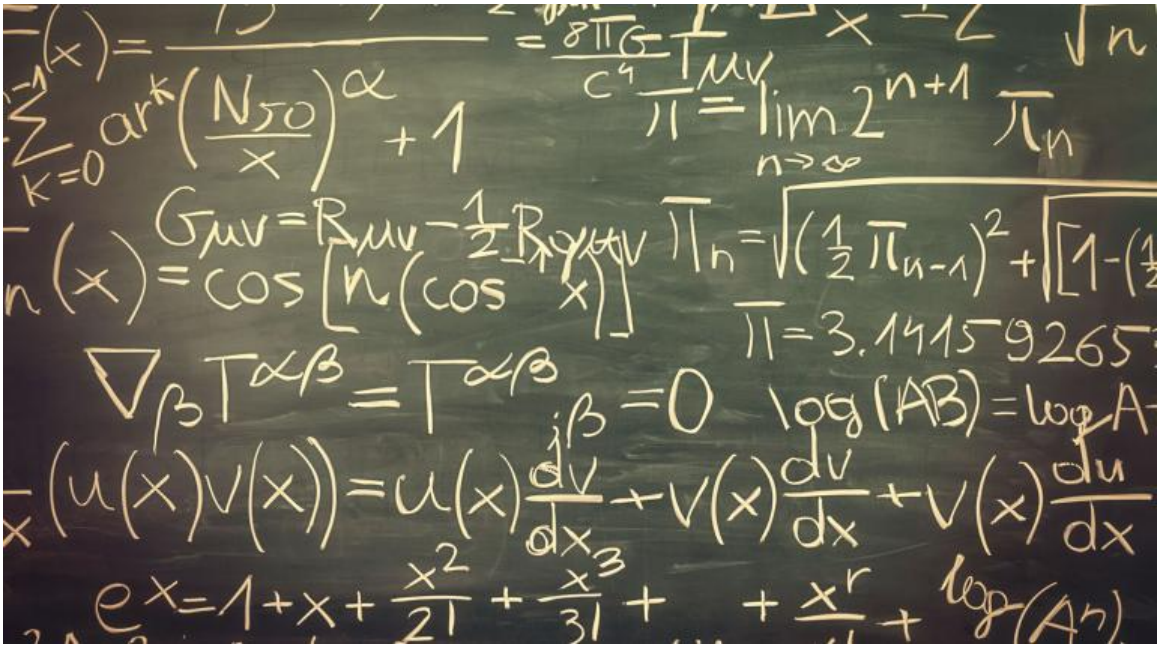

This book is dedicated to the memory of

Professor Anadi Sankar Gupta,

former Head of Department of Mathematics,

Indian Institute of Technology, Kharagpur,

who instilled in me a passion for mathematics.

Preface

"The language God talks" is a phrase attributed to Richard Feynman the distinguished and nobel prize winning physicist as an encouragement to learn calculus. Mathematics is indeed the language of science. Italian astronomer and physicist Galileo Galilei had stated *"Mathematics is the language in which God has written the universe."*

In 1865, James Clerk Maxwell, a Scottish mathematician at Cambridge University, came up with his seminal work where he presented mathematical equations that unified electricity, magnetism and optics that have contributed immensely to our civilisation. Albert Einstein had said, *"The work of James Clerk Maxwell changed the world forever."* Maxwell was a brilliant mathematician. The mathematical tools he had mastered had been developed a century before. While Michael Faraday and others had been investigating various electrical and magnetic phenonena, Maxwell looked for patterns and with his mathematics, he was able to synthesize all these phenomena.

Mathematics enables us to explore the connection between creativity and structure. Creativity flourishes in a formal mathematical structure, helps us sharpen our critical thinking and master the art of problem solving. One should study mathematics for the same reason that we study art, literature, history and science. The intellectual achievements of Newton, Gauss, Leibniz, Ramanujan in mathematics are at par with those of Tagore, Shakespeare and Leonardo da Vinci in art. Often the usefulness of mathematics is the only thing that is emphasized and mathematics is viewed as a toolbox, but it is much more than that. Understanding mathematics should be a desirable objective of everyone one and not limited to students of science and engineering. Mathematics enables us to be objective, quantitative and succinct in our communication. The process of problem-solving in mathematics helps us develop patience and resilience.

This book is intended to introduce students of engineering, physics, mathematics, computer science, and related fields to a comprehensive set of concepts in mathematics that are required for solving real world problems. Content is ever growing, the curriculum for many students is pretty much full and time is short and precious. This book provides a crisp and concise understanding of the fundamental concepts in engineering mathematics that are essential to comprehend natural and engineered phenomena. The book is described as a *handbook* as it is designed to be a ready reference to the fundamental concepts along with their proofs.

The most common misconception about mathematics is that it is a skill that comes naturally. Most of mathematics is not about natural talent, rather it is about one's approach to learning. Just as in any other skill, success comes with practice.

With the advent of symbolic computing, the drudgery has been signficantly reduced. Throughout the book, examples are listed using *sympy*, *numpy*, *python* and *jupyterlab* to help visualize the solutions. The book is somewhat unique in that sense.

The author is a retired software executive with a profound interest in quantitative methods. He holds a Doctor of Science and Master of Science degree from the Massachusetts Institute of Technology (MIT), following his undergraduate studies at the Indian Institute of Technology (IIT) Kharagpur.

I hope you will enjoy reading this book and develop a deep interest in mathematics.

Jaideep Ganguly

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