Preface

This special edition presents a series of explorations in the two foundational areas: materials and structural integrity of engineering objects – fields that continue to define the strength, reliability, and performance of modern engineering systems. The edition is designed to serve as both a scholarly reference and a practical guide for engineers, researchers, and students seeking a deeper understanding of material behaviour, processing, and failure mechanisms.

Chapter 1: Properties and Processing of Structural Metals provides an in-depth overview of the fundamental characteristics of metallic materials used in machinery for structural applications. It examines the relationships between microstructure, composition, and mechanical properties, while emphasising modern manufacturing processes such as alloy synthesis, additive manufacturing, and electro-discharge machining. This chapter also highlights recent advances in superalloys and high-entropy alloys, which are crucial for the aerospace, automotive, and energy sectors.

Chapter 2: Fracture Mechanics and Failure Analysis of Materials and Structures delves into the science and methodology of predicting and understanding material failure. It discusses the principles of fracture mechanics, fatigue life prediction, and crack propagation analysis, integrating theoretical frameworks with experimental and computational approaches. The chapter also presents case studies on structural integrity, highlighting the importance of failure analysis in enhancing design standards, safety protocols, and material selection strategies.

By combining insights from material processing with the mechanics of failure, this special edition promotes an integrated approach to design and analysis, enabling engineers to develop safer, stronger, and more efficient systems.