

# Analytic Methods in Physics

Charlie Harper

## Analytic Methods in Physics

$$\begin{aligned} x &= \rho \cdot \cos \gamma \\ \psi(r, \theta, \phi) &= -C_{nl} R_{nl}(\xi) Y_l^m(\theta, \phi) \\ F \cdot d\sigma &= \nabla \cdot F d\tau \quad i\hbar \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m} \nabla^2 \psi + V(x, y, z) \\ + \mathbf{k} \frac{\partial}{\partial z} & \quad F(k, y) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(x, y) e^{ikx} dx \\ \nabla &= i \frac{\partial}{\partial x} + i \frac{\partial}{\partial y} + \mathbf{k} \frac{\partial}{\partial z} \quad [X_i, X_j] = \sum_{k=1}^n C_{ij}^k I_k \\ & \quad \nabla \cdot A = \nabla^2 A \end{aligned}$$

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This book is intended for undergraduate students who are majoring in physics (or other physical sciences), applied mathematics, or engineering. The goal of the book is to provide the essential mathematical physics background needed for the study of analytic mechanics and mechanical wave motion, heat and thermodynamics, electromagnetism, modern physics, and quantum mechanics. In addition, it is intended to provide the necessary background for advanced work in these areas. Numerous examples and illustrations are given throughout each chapter, and problems are included at the end of each chapter. Certain problems are used to introduce new material in a self-contained manner. Throughout the book, the level of presentation is fairly uniform (with the possible exception of certain sections of chapters 2 and 12), and the included material should be readily accessible to undergraduate students who have a working knowledge of general physics and of differential and integral calculus. The desire to maintain a uniform level of presentation was used as a guide for the selection of topics to include (and exclude). The material on essentials of vector spaces, essential algebraic structures, and exterior differential forms is invaluable for the study of physics today; the inclusion and presentation of this material at the undergraduate level are among the distinguishing features of this book.

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