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Mathematical Methods in Physics

Distributions, Hilbert Space Operators, Variational Methods, and
Applications in Quantum Physics, Second Edition

The second edition of this textbook presents the basic mathematical knowledge
and skills that are needed for courses on modern theoretical physics, such as those
on quantum mechanics, classical and quantum field theory, and related areas. The
authors stress that learning mathematical physics is not a passive process and include
numerous detailed proofs, examples, and over 200 exercises, as well as hints linking
mathematical concepts and results to the relevant physical concepts and theories. All
of the material from the first edition has been updated, and five new chapters have been
added on such topics as distributions, Hilbert space operators, and variational methods.

The text is divided into three main parts. Part I is a brief introduction to distribution
theory, in which elements from the theories of ultradistributions and hyperfunctions
are considered in addition to some deeper results for Schwartz distributions, thus
providing a comprehensive introduction to the theory of generalized functions. Part
II contains fundamental facts about Hilbert spaces and their geometry. The theory
of linear operators, both bounded and unbounded, is developed, focusing on results
needed for the theory of Schrödinger operators. Part III treats the direct methods of the
calculus of variations and their applications to boundary- and eigenvalue-problems for
linear and nonlinear partial differential operators. The appendices contain proofs of
more general and deeper results, including completions, basic facts about metrizable
Hausdorff locally convex topological vector spaces, Baire's fundamental results and
their main consequences, and bilinear functionals.

Mathematical Methods in Physics is aimed at a broad community of graduate students
in mathematics, mathematical physics, quantum information theory, physics and
engineering, as well as researchers in these disciplines. Expanded content and relevant
updates will make this new edition a valuable resource for those working in these
disciplines.