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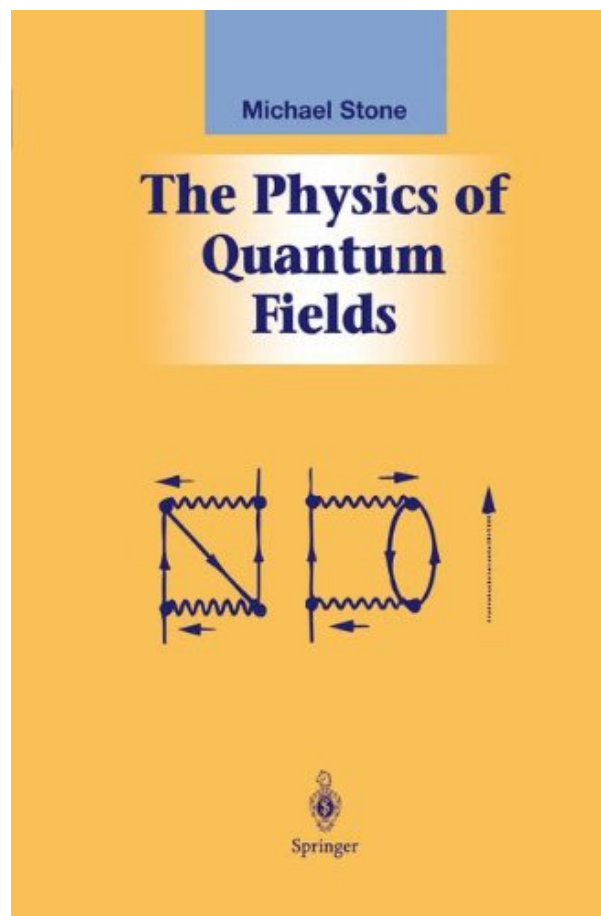

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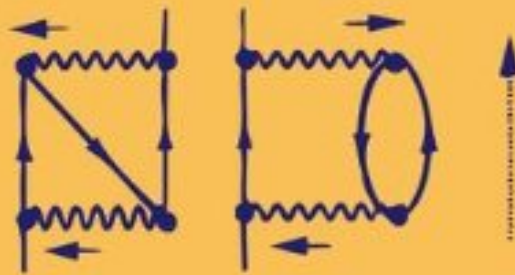BY MICHAEL STONE**

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A gentle introduction to the physics of quantized fields and many-body physics. Based on courses taught at the University of Illinois, it concentrates on the basic conceptual issues that many students find difficult, and emphasizes the physical and visualizable aspects of the subject. While the text is intended for students with a wide range of interests, many of the examples are drawn from condensed matter physics because of the tangible character of such systems. The first part of the book uses the Hamiltonian operator language of traditional quantum mechanics to treat simple field theories and related topics, while the Feynman path integral is introduced in the second half where it is seen as indispensable for understanding the connection between renormalization and critical as well as non-perturbative phenomena.

- Sales Rank: #4528195 in Books
- Published on: 1999-12-28
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .75" w x 6.14" l, 1.26 pounds
- Binding: Hardcover
- 271 pages

Most helpful customer reviews

0 of 0 people found the following review helpful.
Compact Compendium for Condensed Matter
By G. A. Schoenagel
This text, under Springer's line of Graduate Texts in Contemporary Physics, does serve a purpose.
As others have noted, it is terse and advanced. It is slimmer than many other Quantum Field Theory textbooks.
(Note: Banks, Modern Quantum Field Theory,2008, is another text of comparable length !).
Therefore, one must be cognizant of the student for whom this book is addressed. And, who might that be ?
My advice: Peruse the seven appendices. If you are able to follow the reasoning and (especially) the mathematical
derivations, then chances are good that this textbook will be readily assimilated. However, even then, you will be
challenged throughout the text to supply missing derivations. This, not a bad thing, as it reinforces stamina for the
graduate student. In order to appreciate the text, one must (at the very least) be adept at "filling in the details."
First Chapter will be much in the nature of review: Classical and Quantum Mechanics should already be embedded in
your memory. Dirac Deltas and Fourier Series should already be part and parcel of your background. If not, then this
chapter will be your first challenging exercise ! Notice: mention of Casimir energy and Spontaneous

Symmetry Breaking,

already on Page 10. Onward to Relativistic considerations in Chapter Two:

Recall the use of dimensional analysis and the metric of Special Relativity. Lagrangians and internal symmetry are given

a nice, though brief, exposition. Already, Page 24, we are introduced to phonons and a scalar-field analog of Poynting Vector !

Creation and Annihilation Operators--these are the substance of the first two chapters. Facility in manipulating these entities

must be second-nature. (Obviously, these operators should have been mastered in your Quantum Mechanics Course).

Thus, is completed twenty pages of this book. Fast-paced, but, so far, most of this material should be in the nature of review.

Third Chapter, Perturbation Theory. Now, we enter the realm of heavy computation. If Green's Functions and contour integrals

are foreign to you, then this will be a difficult Chapter. Wick's Theorem nicely expounded. Applications then follow--that is,

Yukawa Potential and Mossbauer Effect. The qualitative discussion which accompanies is to be noted for its profundity.

Feynman Rules are next. Follow along with paper and pencil . As the author says: "....a little playing around will convince you...."

(see Page 42). Some wise words from the author help to make this difficult chapter palatable. As one ascertains, the book's

pace is accelerating (Chapter's One and Two were simpler meal rations, Three and Four are the meat and potatoes).

Fifth Up: Loops, Unitarity and Analyticity. Now, if your complex variable theory is rusty, you will be completely lost.

A tough chapter, ending with a nice section on Dimensional Regularization. (Memorize the Feynman Integral Identities,

that is, section 5.32. And, if deriving equation 5.45 from 5.44 proves difficult, then you have lost something along the way).

As the reader can see, much ground has been covered in sixty pages ! This is fast paced, indeed. If, however, the text is

being utilized in a course, alongside lectures and assistance--then, it should be assailable. And, so we progress. Next,

considered: Formalities (LSZ sketched), followed by Fermions (This,an exceptional Chapter Seven) as prelude to QED.

We read: "The Ward Identity is a route to establishing gauge invariance." (Page 92). From QED to electrons in solids.

Determinants, Green's Functions, Fourier Transforms, Chapter Nine,thus replete with the full mathematical panoply.

And, it goes without saying, if your mathematics is rusty, all will remain quite foreign . Applications in Chapter Nine

are interesting and insightful (including Debye screening, Plasma Oscillations, Landau Damping)...models and modelling.

Bosons, of course, follow. This includes thoughtful qualitative discussion. But, note, too (Page 131) : "The nonlinear

Schrodinger equation we get by varying the action--that is, varying equation 10.41, is often used as a model...." Again,

if the student is unable to perform said variation of the action, then all that follows will make little sense. So,

try it !

Interesting mathematics is met throughout: Matsubara Sums , the incredibly useful identity: In Det A= Tr In A,

Complex Fields, Generating Functionals, Expansions, Gamma Functions, Berezin Integrals (Chapter 14: Path Integrals).

The list can be expanded: Clifford Algebra (Page 72), Automorhism Group (Page 39), Heron's Area Formula (Page 46).

What one quickly ascertains is that you do not get far without "doing the math" which comes along for the Physics ride.

A nice mention of Supersymmetry--alongside Gaussian Integrals (Pages 174-177), makes for fascinating interlude.

Green, Fourier, Cauchy: If your math is not up to par, this text will prove impenetrable. Perhaps, as I have done,the point

needs to be stressed. This is not such a bad text. It requires some work. Examples of such work, left for the student:

(1) Page 57: "Expansion of In(1+x) and perform the sum..."

(2) Page 33: " We see that the energy of interaction is...."

(3) Page 48: "..and do the x-integral..."

(4) Page 87: " the inverse of the matrix is easily found, and we find for the propagator..."

(5) Page 115 : "In Fourier Space, 9.85.9.86 & 9.87 combine to give..."

Prerequisites should be firmly in hand. The book, while brief, has performed a service, and, as set forth in the Preface:

"...many examples in the text are drawn from the field of Condensed Matter physics..." and "....tried to concentrate on the

basic conceptual issues." Part One (to chapter eleven) emphasizes Operator methods.Part Two (Later): Path Integral Methods.

But, as with any Graduate-level textbook, if your undergraduate physics and mathematics is spotty, or cursory, then much

here will be extremely challenging.(Collateral Study of Chang's 1990 text Introduction to Quantum Field Theory, also with a

two-pronged Operators/Path Integrals approach--but,including Schwinger-- will prove invaluable !).

Thus, recommended for a compact, advanced, presentation of basics--

basics then applied to condensed matter systems.

1 of 2 people found the following review helpful.

Sadly, this might be the best book available

By Dorfl

This book really isn't very good. If you have a lecturer simultaneously teaching you Quantum Field Theory, it can be useful to refer back to this book for the occasional thing you might have missed. But getting any useful kind of understanding of QFT only from this book is probably impossible.

The main problem with the book is that it leaves out important steps that, if you can fill them in on your own, you already know the subject well enough that you probably don't need the book. This applies to both the mathematical derivations and the text itself.

An example is the chapter on Feynman rules, which in the third paragraph begins discussing how to "determine to which matrix elements of S the diagram corresponds when sandwiched between initial and final states", without first bothering to explain what diagrams are being talked about, or what it even means for a diagram to 'correspond' to a matrix element.

My QFT lecturer has acknowledged that the book is fairly bad, which irate students point out to him every time the course is given, but claims he has not been able to find any better alternative.

4 of 15 people found the following review helpful.
too many typo
By A. Konik
steps are not very clear for an introductory book

and there are too many typos in the first edition

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