

PREFACE

This book originates from a set of lecture notes for a two-semester graduate course in quantum field theory which the author taught at the University of Illinois. The purpose of the first part of the book is to teach a graduate student the basic skill of perturbation theory in both particle physics and in many-body physics. We expect that the student has a general background in nonrelativistic quantum mechanics. We begin with a quantum system with a finite number of particles and then generalize it to the quantum field. We follow Dyson-Wick's approach, and introduce Feynman diagrams. We apply the diagrammatic technique to quantum electrodynamics and to zero-temperature many-body system.

In the second part of the book, we begin with Schwinger's action principle. Schwinger's action principle is probably the most elegant method of introducing field quantization. The action principle is applicable with ease to both boson fields and fermion fields. We illustrate how to construct stress tensors and how to verify Lorentz invariance in the framework of quantum field theory. Next we develop Feynman's path integral method which is complementary to Schwinger's differential method. Path integral formulation provides the most efficient way of deriving Feynman rules for non-abelian gauge theories. A serious theory student should master both methods. The remaining part of the book is devoted to renormalization theory including the renormalization group method.

The following excellent books provide additional reading and references:

1. J. Schwinger, ed., *Quantum Electrodynamics*, Dover, New York, 1958.
2. J. D. Bjorken and S. D. Drell, *Relativistic Quantum Mechanics*, McGraw-Hill, New York, 1964, and *Relativistic Quantum Fields*, McGraw-Hill, New York, 1965.
3. R. P. Feynman and A. R. Hibbs, *Quantum Mechanics and Path Integrals*, McGraw-Hill, New York, 1965.
4. A. L. Fetter and J. D. Walecka, *Quantum Theory of Many-Particle*

Systems, McGraw-Hill, New York, 1971.

5. C. Itzykson and J. B. Zuber, *Quantum Field Theory*, McGraw-Hill, New York, 1971.
6. D. J. Amit, *Field Theory, the Renormalization Group, and Critical Phenomena*, World Scientific, Singapore, 1984.

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