

# **Field Theory And Its Classical Problems Carus Mathematical Monographs No 19 Mathematical Association Of America Textbooks**

Contemporary Sociological Theory and Its Classical Roots  
Classical Field Theory  
Fields, Symmetries, and Quarks  
Classical Theory of Gauge Fields  
The Classical Electromagnetic Field  
The Classical Theory of Fields  
Quantum Field Theory  
Gauge Field Theories  
Classical Covariant Fields  
Electrodynamics and Classical Theory of Fields and Particles  
Gravitation, Gauge Theories and the Early Universe  
Classical Field Theory  
Quantum Field Theory  
Advanced Classical Field Theory  
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Geometry of Classical Fields  
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From Classical to Quantum Fields  
Connections in Classical and Quantum Field Theory  
Classical Field Theory  
The Classical Theory of Fields  
Classical Theory of Electric and Magnetic Fields  
The Classical Theory of Fields  
Foundations of Physics  
Introduction to Classical Field Theory  
Introduction to Classical and Quantum Field Theory  
Field Theory and Its Classical Problems  
Introduction to the Classical Theory of Particles and Fields  
Decoherence and the Appearance of a Classical World in Quantum Theory  
Field Theory and Its Classical Problems  
Introduction to Classical Field Theory  
Twistor Geometry and Field Theory  
Classical Field Theory  
Quantum Field Theory in a Semiotic Perspective  
From Classical Mechanics To Quantum Field

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Theory, A Tutorial  
The Conceptual Framework of Quantum Field Theory  
From Classical Field Theory to Perturbative Quantum Field Theory  
Classical Field Theory  
Special Relativity and Classical Field Theory

### **Contemporary Sociological Theory and Its Classical Roots**

A canonical quantization approach to classical field theory, this text is suitable for mathematicians interested in theoretical physics as well as to theoretical physicists who use differential geometric methods in their modelling. Introduces differential geometry, the theory of Lie groups, and progresses to discuss the systematic development of a covariant Hamiltonian formulation of field theory. 1988 edition.

### **Classical Field Theory**

Following on from the successful first (1984) and revised (1993) editions, this extended and revised text is designed as a short and simple introduction to quantum field theory for final year physics students and for postgraduate students beginning research in theoretical and experimental particle physics. The three main objectives of the book are to: Explain the basic physics and formalism of quantum field theory To make the reader proficient in theory calculations using Feynman diagrams To introduce the reader to gauge theories, which play a central

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role in elementary particle physics. Thus, the first ten chapters deal with QED in the canonical formalism, and are little changed from the first edition. A brief introduction to gauge theories (Chapter 11) is then followed by two sections, which may be read independently of each other. They cover QCD and related topics (Chapters 12-15) and the unified electroweak theory (Chapters 16 - 19) respectively. Problems are provided at the end of each chapter. New to this edition: Five new chapters, giving an introduction to quantum chromodynamics and the methods used to understand it: in particular, path integrals and the renormalization group. The treatment of electroweak interactions has been revised and updated to take account of more recent experiments.

### **Fields, Symmetries, and Quarks**

This book is a short introduction to classical field theory, most suitable for undergraduate students who have had at least intermediate-level courses in electromagnetism and classical mechanics. The main theme of the book is showcasing role of fields in mediating action-at-a-distance interactions. Suitable technical machinery is developed to explore at least some aspect of each of the four known fundamental forces in nature. Beginning with the physically-motivated introduction to field theory, the text covers the relativistic formulation of electromagnetism in great detail so that aspects of gravity and the nuclear interaction not usually encountered at the undergraduate level can be covered by

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using analogies with familiar electromagnetism. Special topics such as the behavior of gravity in extra, compactified dimensions, magnetic monopoles and electromagnetic duality, and the Higgs mechanism are also briefly considered.

### **Classical Theory of Gauge Fields**

Overview of classical solutions and their consequences in quantum field theory, high energy physics and cosmology for graduates and researchers.

### **The Classical Electromagnetic Field**

The study of classical electromagnetic fields is an adventure. The theory is complete mathematically and we are able to present it as an example of classical Newtonian experimental and mathematical philosophy. There is a set of foundational experiments, on which most of the theory is constructed. And then there is the bold theoretical proposal of a field-field interaction from James Clerk Maxwell. This textbook presents the theory of classical fields as a mathematical structure based solidly on laboratory experiments. Here the student is introduced to the beauty of classical field theory as a gem of theoretical physics. To keep the discussion fluid, the history is placed in a beginning chapter and some of the mathematical proofs in the appendices. Chapters on Green's Functions and

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Laplace's Equation and a discussion of Faraday's Experiment further deepen the understanding. The chapter on Einstein's relativity is an integral necessity to the text. Finally, chapters on particle motion and waves in a dispersive medium complete the picture. High quality diagrams and detailed end-of-chapter questions enhance the learning experience.

### **The Classical Theory of Fields**

The book describes Maxwell's equations first in their integral, directly testable form, then moves on to their local formulation. The first two chapters cover all essential properties of Maxwell's equations, including their symmetries and their covariance in a modern notation. Chapter 3 is devoted to Maxwell theory as a classical field theory and to solutions of the wave equation. Chapter 4 deals with important applications of Maxwell theory. It includes topical subjects such as metamaterials with negative refraction index and solutions of Helmholtz' equation in paraxial approximation relevant for the description of laser beams. Chapter 5 describes non-Abelian gauge theories from a classical, geometric point of view, in analogy to Maxwell theory as a prototype, and culminates in an application to the  $U(2)$  theory relevant for electroweak interactions. The last chapter 6 gives a concise summary of semi-Riemannian geometry as the framework for the classical field theory of gravitation. The chapter concludes with a discussion of the Schwarzschild solution of Einstein's equations and the classical tests of general

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relativity (perihelion precession of Mercury, and light deflection by the sun). -----  
Textbook features: detailed figures, worked examples, problems and solutions, boxed inserts, highlighted special topics, highlighted important math etc., helpful summaries, appendix, index.

### **Quantum Field Theory**

Comprehensive graduate-level text by a distinguished theoretical physicist reveals the classical underpinnings of modern quantum field theory. Topics include space-time, Lorentz transformations, conservation laws, equations of motion, Green's functions, and more. 1964 edition.

### **Gauge Field Theories**

The author uses a unique approach which emphasizes the field theoretic aspects of gravitation and the strong analogies between gravitation and the other areas that are studied in physics. The theory-centered text begins with the simplest experimental facts then proceeds to the corresponding differential equations, theoretical constructs such as energy, momentum and stress and several applications. End-of-chapter problems provide students with an opportunity to test their understanding, serve as an introduction to and a review of material not

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included in the book and can be used to develop examples, extensions and generalizations of the material presented.

### **Classical Covariant Fields**

Classical Theory of Electric and Magnetic Fields is a textbook on the principles of electricity and magnetism. This book discusses mathematical techniques, calculations, with examples of physical reasoning, that are generally applied in theoretical physics. This text reviews the classical theory of electric and magnetic fields, Maxwell's Equations, Lorentz Force, and Faraday's Law of Induction. The book also focuses on electrostatics and the general methods for solving electrostatic problems concerning images, inversion, complex variable, or separation of variables. The text also explains magnetostatics and compares the calculation methods of electrostatics with those of magnetostatics. The book also discusses electromagnetic wave phenomena concerning wave equations with a source term and the Maxwell equations which are linear and homogenous. The book also explains Einstein's the Special Theory of Relativity which is applicable' only to inertial coordinate systems. The text also discusses the particle aspects of electromagnetic field equations such as those concerning wave equations for particles with spin. This textbook is intended for graduate or advanced students and academicians in the field of physics.

## **Electrodynamics and Classical Theory of Fields and Particles**

This book is a short introduction to classical field theory, most suitable for undergraduate students who have had at least intermediate-level courses in electromagnetism and classical mechanics. The main theme of the book is showcasing role of fields in mediating action-at-a-distance interactions. Suitable technical machinery is developed to explore at least some aspect of each of the four known fundamental forces in nature. Beginning with the physically-motivated introduction to field theory, the text covers the relativistic formulation of electromagnetism in great detail so that aspects of gravity and the nuclear interaction not usually encountered at the undergraduate level can be covered by using analogies with familiar electromagnetism. Special topics such as the behavior of gravity in extra, compactified dimensions, magnetic monopoles and electromagnetic duality, and the Higgs mechanism are also briefly considered.

## **Gravitation, Gauge Theories and the Early Universe**

Classical field theory predicts how physical fields interact with matter, and is a logical precursor to quantum field theory. This introduction focuses purely on modern classical field theory, helping graduates and researchers build an understanding of classical field theory methods before embarking on future studies

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in quantum field theory. It describes various classical methods for fields with negligible quantum effects, for instance electromagnetism and gravitational fields. It focuses on solutions that take advantage of classical field theory methods as opposed to applications or geometric properties. Other fields covered includes fermionic fields, scalar fields and Chern–Simons fields. Methods such as symmetries, global and local methods, Noether theorem and energy momentum tensor are also discussed, as well as important solutions of the classical equations, in particular soliton solutions.

### **Classical Field Theory**

This revised and extended edition of the book *Fields, Symmetries, and Quarks*, originally published by McGraw-Hill Book Company, Hamburg, 1989, contains a new chapter on electroweak interactions which has also grown out of lectures that I have given in the meantime. In addition, a number of changes, mainly in the metric used, in the discussion of the theory of strong interactions, QCD, and in the chapter on hadron physics, have been made and errors have been corrected. The motivation for this book, however, is still the same as it was 10 years ago: This is a book on quantum field theory and our present understanding of leptons and hadrons for advanced students and the non-specialists and, in particular, the experimentalists working on problems of nuclear and hadron physics. I am grateful to Dr. S. Leupold for a very careful reading of the revised manuscript, many

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corrections, and helpful suggestions and to C. Traxler for producing the figures and for constructive discussions.

### **Quantum Field Theory**

Deals with the twistor treatment of certain linear and non-linear partial differential equations. The description in terms of twistors involves algebraic and differential geometry, and several complex variables.

### **Advanced Classical Field Theory**

Now with SAGE Publishing, *Contemporary Sociological Theory and Its Classical Roots: The Basics*, is a brief survey of sociology's major theorists and theoretical approaches, from the Classical founders to the present. With updated scholarship in the new Fifth Edition, authors George Ritzer and Jeffrey Stepnisky connect many theorists and schools of thought together under broad headings that offer students a synthesized view of sociological theory. This text is perfect for those who want an accessible overview of the entire tradition of sociological thinking, with an emphasis on the contemporary relevance of theory.

### **The Classical Theory of Fields**

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Geometrical notions and methods play an important role in both classical and quantum field theory, and a connection is a deep structure which apparently underlies the gauge-theoretical models in field theory and mechanics. This book is an encyclopaedia of modern geometric methods in theoretical physics. It collects together the basic mathematical facts about various types of connections, and provides a detailed exposition of relevant physical applications. It discusses the modern issues concerning the gauge theories of fundamental fields. The authors have tried to give all the necessary mathematical background, thus making the book self-contained. This book should be useful to graduate students, physicists and mathematicians who are interested in the issue of deep interrelations between theoretical physics and geometry. keywords:Lagrangian Field Theory;Hamiltonian Field Theory;Classical Mechanics;BRST Formalism;Topological Field Theories;Non-Commutative Geometry;Theoretical Physics;Mathematical Physics;Fibre Bundle;Connection;Jet Manifold;Gauge Theory;Gravitation;Theory;Quantum Field;Geometric Quantization;Supergeometry;BRST;Theory “this book certainly offers a valuable supplement to the existing literature on the impact of connection theory on theoretical physics.” Mathematical Reviews

### **Geometry of Classical Fields**

This book develops a novel approach to perturbative quantum field theory: starting with a perturbative formulation of classical field theory, quantization is achieved by

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means of deformation quantization of the underlying free theory and by applying the principle that as much of the classical structure as possible should be maintained. The resulting formulation of perturbative quantum field theory is a version of the Epstein-Glaser renormalization that is conceptually clear, mathematically rigorous and pragmatically useful for physicists. The connection to traditional formulations of perturbative quantum field theory is also elaborated on, and the formalism is illustrated in a wealth of examples and exercises.

### **Classical Solutions in Quantum Field Theory**

This text concerns continuum mechanics, electrodynamics and the mechanics of electrically polarized media, and gravity. Geared toward advanced undergraduates and graduate students, it offers an accessible approach that formulates theories according to the principle of least action. The chief advantage of this formulation is its simplicity and ease, making the physical content of classical subjects available to students of physics in a concise form. Author Davison E. Soper, a Professor of Physics at the University of Oregon, intended this treatment as a primary text for courses in classical field theory as well as a supplement for courses in classical mechanics or classical electrodynamics. Topics include fields and transformation laws, the principle of stationary action, general features of classical field theory, the mechanics of fluids and elastic solids, special types of solids, nonrelativistic approximations, and the electromagnetic field. Additional subjects include

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electromagnetically polarized materials, gravity, momentum conservation in general relativity, and dissipative processes.

### **Classical Field Theory**

An expanded and up-dated book examining gauge theories and their symmetries.

### **From Classical to Quantum Fields**

An introduction to the classical notions behind modern Galois theory.

### **Connections in Classical and Quantum Field Theory**

Scheck's successful textbook presents a comprehensive treatment, ideally suited for a one-semester course. The textbook describes Maxwell's equations first in their integral, directly testable form, then moves on to their local formulation. The first two chapters cover all essential properties of Maxwell's equations, including their symmetries and their covariance in a modern notation. Chapter 3 is devoted to Maxwell's theory as a classical field theory and to solutions of the wave equation. Chapter 4 deals with important applications of Maxwell's theory. It includes topical subjects such as metamaterials with negative refraction index and

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solutions of Helmholtz' equation in paraxial approximation relevant for the description of laser beams. Chapter 5 describes non-Abelian gauge theories from a classical, geometric point of view, in analogy to Maxwell's theory as a prototype, and culminates in an application to the  $U(2)$  theory relevant for electroweak interactions. The last chapter 6 gives a concise summary of semi-Riemannian geometry as the framework for the classical field theory of gravitation. The chapter concludes with a discussion of the Schwarzschild solution of Einstein's equations and the classical tests of general relativity. The new concept of this edition presents the content divided into two tracks: the fast track for master's students, providing the essentials, and the intensive track for all wanting to get in depth knowledge of the field. Clearly labeled material and sections guide students through the preferred level of treatment. Numerous problems and worked examples will provide successful access to Classical Field Theory.

### **Classical Field Theory**

The study of classical electromagnetic fields is an adventure. The theory is complete mathematically and we are able to present it as an example of classical Newtonian experimental and mathematical philosophy. There is a set of foundational experiments, on which most of the theory is constructed. And then there is the bold theoretical proposal of a field-field interaction from James Clerk Maxwell. This textbook presents the theory of classical fields as a mathematical

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structure based solidly on laboratory experiments. Here the student is introduced to the beauty of classical field theory as a gem of theoretical physics. To keep the discussion fluid, the history is placed in a beginning chapter and some of the mathematical proofs in the appendices. Chapters on Green's Functions and Laplace's Equation and a discussion of Faraday's Experiment further deepen the understanding. The chapter on Einstein's relativity is an integral necessity to the text. Finally, chapters on particle motion and waves in a dispersive medium complete the picture. High quality diagrams and detailed end-of-chapter questions enhance the learning experience.

### **The Classical Theory of Fields**

Classical field theory, which concerns the generation and interaction of fields, is a logical precursor to quantum field theory, and can be used to describe phenomena such as gravity and electromagnetism. Written for advanced undergraduates, and appropriate for graduate level classes, this book provides a comprehensive introduction to field theories, with a focus on their relativistic structural elements. Such structural notions enable a deeper understanding of Maxwell's equations, which lie at the heart of electromagnetism, and can also be applied to modern variants such as Chern-Simons and Born-Infeld. The structure of field theories and their physical predictions are illustrated with compelling examples, making this book perfect as a text in a dedicated field theory course, for self-study, or as a

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reference for those interested in classical field theory, advanced electromagnetism, or general relativity. Demonstrating a modern approach to model building, this text is also ideal for students of theoretical physics.

### **Classical Theory of Electric and Magnetic Fields**

Contemporary quantum field theory is mainly developed as quantization of classical fields. Therefore, classical field theory and its BRST extension is the necessary step towards quantum field theory. This book aims to provide a complete mathematical foundation of Lagrangian classical field theory and its BRST extension for the purpose of quantization. Based on the standard geometric formulation of theory of nonlinear differential operators, Lagrangian field theory is treated in a very general setting. Reducible degenerate Lagrangian theories of even and odd fields on an arbitrary smooth manifold are considered. The second Noether theorems generalized to these theories and formulated in the homology terms provide the strict mathematical formulation of BRST extended classical field theory. The most physically relevant field theories OCo gauge theory on principal bundles, gravitation theory on natural bundles, theory of spinor fields and topological field theory OCo are presented in a complete way. This book is designed for theoreticians and mathematical physicists specializing in field theory. The authors have tried throughout to provide the necessary mathematical background, thus making the exposition self-contained.

## **The Classical Theory of Fields**

This book collects an extended version of the lectures delivered by the authors at the Fall Workshop on Geometry and Physics in the years 2014, 2015, 2016. It aims at introducing advanced graduate and PhD students, as well as young researchers, to current research in mathematics and physics. In particular, it fills the gap between the more physical-oriented and the more mathematical-oriented literature on quantum theory. It introduces various approaches to methods of quantization, along with their impact on modern mathematical methods.

## **Foundations of Physics**

Viewing physical theories as symbolic constructions came to the fore in the middle of the nineteenth century with the emancipation of the classical theory of the electromagnetic field from mechanics; most notably this happened through the work of Helmholtz, Hertz, Poincaré, and later Weyl. The epistemological problems that nourished this development are today highlighted within quantum field theory. The present essay starts off with a concise and non-technical outline of the firmly based aspects of relativistic quantum field theory, i.e. the very successful description of subnuclear phenomena. The particular methods, by which these different aspects have to be accessed, then get described as distinct facets of

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quantum field theory. The authors show how these different facets vary with respect to the relation between quantum fields and associated particles. Thus, by emphasising the respective role of various basic concepts involved, the authors claim that only a very general epistemic approach can properly account for this diversity - an account they trace back to the philosophical writings of the aforementioned physicists and mathematicians. Finally, what they call their semiotic perspective on quantum field theory gets related to recent discussions within the philosophy of science and turns out to act as a counterbalance to, for instance, structural realism.

### **Introduction to Classical Field Theory**

This book is a modern introduction to the ideas and techniques of quantum field theory. After a brief overview of particle physics and a survey of relativistic wave equations and Lagrangian methods, the author develops the quantum theory of scalar and spinor fields, and then of gauge fields. The emphasis throughout is on functional methods, which have played a large part in modern field theory. The book concludes with a brief survey of "topological" objects in field theory and, new to this edition, a chapter devoted to supersymmetry. Graduate students in particle physics and high energy physics will benefit from this book.

## **Introduction to Classical and Quantum Field Theory**

This volume is intended as a systematic introduction to gauge field theory for advanced undergraduate and graduate students in high energy physics. The discussion is restricted to the classical (non-quantum) theory in Minkowski spacetime. Particular attention has been given to conceptual aspects of field theory, accurate definitions of basic physical notions, and thorough analysis of exact solutions to the equations of motion for interacting systems.

## **Field Theory and Its Classical Problems**

Translated from the 6th Russian edition, this latest edition contains seven new sections with chapters on General Relativity, Gravitational Waves and Relativistic Cosmology, where Professor Lifshitz's interests lay. The text of the 3rd English edition has been thoroughly revised and additional problems inserted

## **Introduction to the Classical Theory of Particles and Fields**

Quantum Field Theory has become the universal language of most modern theoretical physics. This introductory textbook shows how this beautiful theory offers the correct mathematical framework to describe and understand the

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fundamental interactions of elementary particles. The book begins with a brief reminder of basic classical field theories, electrodynamics and general relativity, as well as their symmetry properties, and proceeds with the principles of quantisation following Feynman's path integral approach. Special care is used at every step to illustrate the correct mathematical formulation of the underlying assumptions. Gauge theories and the problems encountered in their quantisation are discussed in detail. The last chapters contain a full description of the Standard Model of particle physics and the attempts to go beyond it, such as grand unified theories and supersymmetry. Written for advanced undergraduate and beginning graduate students in physics and mathematics, the book could also serve as a reference for active researchers in the field.

### **Decoherence and the Appearance of a Classical World in Quantum Theory**

This 2002 book discusses the classical foundations of field theory, using the language of variational methods and covariance. It explores the limits of what can be achieved with purely classical notions, and shows how these have a deep and important connection with the second quantized field theory, which follows on from the Schwinger Action Principle. The book takes a pragmatic view of field theory, focusing on issues which are usually omitted from quantum field theory texts and

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cataloging results which are often hard to find in the literature. Care is taken to explain how results arise and how to interpret them physically, for graduate students starting out in the field. Many physical examples are provided, making the book an ideal supplementary text for courses on elementary field theory, group theory and dynamical systems. It will also be a valuable reference for researchers already working in these and related areas.

### **Field Theory and Its Classical Problems**

The book provides a step by step construction of the framework of relativistic quantum field theory, starting from a minimal set of basic foundational postulates. The emphasis is on a careful and detailed description of the conceptual subtleties of modern field theory, many of which are glossed over in other texts.

### **Introduction to Classical Field Theory**

This book evolved out of some one hundred lectures given by twenty experts at a special instructional conference sponsored by the University Grants Commission, India. It is pedagogical in style and self-contained in several interrelated areas of physics which have become extremely important in present-day theoretical research. The articles begin with an introduction to general relativity and

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cosmology as well as particle physics and quantum field theory. This is followed by reviews of the standard gauge models of high-energy physics, renormalization group and grand unified theories. The concluding parts of the book comprise discussions in current research topics such as problems of the early universe, quantum cosmology and the new directions towards a unification of gravitation with other forces. In addition, special concise treatments of mathematical topics of direct relevance are also included. The content of the book was carefully worked out for the mutual education of students and research workers in general relativity and particle physics. This ambitious programme consequently necessitated the involvement of a number of different authors. However, care has been taken to ensure that the material meshes into a unified, cogent and readable book. We hope that the book will serve to initiate and guide a student in these different areas of investigation starting from first principles and leading to the exciting current research problems of an interdisciplinary nature in the context of the origin and structure of the universe.

### **Twistor Geometry and Field Theory**

A funny, insightful, and self-contained guide to Einstein's relativity theory and classical field theories--including electromagnetism Physicist Leonard Susskind and data engineer Art Friedman are back. This time, they introduce readers to Einstein's special relativity and Maxwell's classical field theory. Using their typical

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brand of real math, enlightening drawings, and humor, Susskind and Friedman walk us through the complexities of waves, forces, and particles by exploring special relativity and electromagnetism. It's a must-read for both devotees of the series and any armchair physicist who wants to improve their knowledge of physics' deepest truths.

### **Classical Field Theory**

Based on a highly regarded lecture course at Moscow State University, this is a clear and systematic introduction to gauge field theory. It is unique in providing the means to master gauge field theory prior to the advanced study of quantum mechanics. Though gauge field theory is typically included in courses on quantum field theory, many of its ideas and results can be understood at the classical or semi-classical level. Accordingly, this book is organized so that its early chapters require no special knowledge of quantum mechanics. Aspects of gauge field theory relying on quantum mechanics are introduced only later and in a graduated fashion--making the text ideal for students studying gauge field theory and quantum mechanics simultaneously. The book begins with the basic concepts on which gauge field theory is built. It introduces gauge-invariant Lagrangians and describes the spectra of linear perturbations, including perturbations above nontrivial ground states. The second part focuses on the construction and interpretation of classical solutions that exist entirely due to the nonlinearity of

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field equations: solitons, bounces, instantons, and sphalerons. The third section considers some of the interesting effects that appear due to interactions of fermions with topological scalar and gauge fields. Mathematical digressions and numerous problems are included throughout. An appendix sketches the role of instantons as saddle points of Euclidean functional integral and related topics. Perfectly suited as an advanced undergraduate or beginning graduate text, this book is an excellent starting point for anyone seeking to understand gauge fields.

### **Quantum Field Theory in a Semiotic Perspective**

This excellent text covers a year's course. Topics include vectors  $D$  and  $H$  inside matter, conservation laws for energy, momentum, invariance, form invariance, covariance in special relativity, and more.

### **From Classical Mechanics To Quantum Field Theory, A Tutorial**

This is not an introduction to physics but an analysis of its foundations. Indeed, the aims of this book are: (1) to analyze the form and content of some of the key ideas of physics; (2) to formulate several basic physical theories in an explicit and orderly (i. e. , axiomatic) fashion; (3) to exhibit their presuppositions and discuss some of their philosophical implications; (4) to discuss some of the controversial

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issues, and (5) to debunk certain dusty philosophical tenets that obscure the understanding of physics and hinder its progress. To the extent to which these goals are attained, the volume can serve as a companion to studies in theoretical physics aiming at deepening the understanding of the logical structure and the physical meaning of our science. In order to keep the book slender, whole fields of basic physical research had to be excluded - chiefly many-body physics, quantum field theories, and elementary particle theories. A large coverage was believed to be less important than a comparatively detailed analysis and reconstruction of three representative monuments: classical mechanics, general relativity, and quantum mechanics, as well as their usually unrecognized presuppositions. The reader is invited to join the project and supply some of the many missing chapters - or to rewrite the present ones entirely.

### **The Conceptual Framework of Quantum Field Theory**

This is the first introductory textbook on quantum field theory to be written from the point of view of condensed matter physics. As such, it presents the basic concepts and techniques of statistical field theory, clearly explaining how and why they are integrated into modern (and classical) field theory, and includes the latest developments. Written by an expert in the field, with a broad experience in teaching and training, it manages to present such substantial topics as phases and phase transitions or solitons and instantons in an accessible and concise way.

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Divided into two parts, the first covers fundamental physics and the mathematics background needed by students in order to enter the field, while the second part discusses applications of quantum field theory to a few basic problems. The emphasis here lies on how modern concepts of quantum field theory are embedded in these approaches, and also on the limitations of standard quantum field theory techniques in facing 'real' physics problems. Throughout, there are numerous end-of-chapter problems, and a free solutions manual is available for lecturers.

### **From Classical Field Theory to Perturbative Quantum Field Theory**

Field Theory and its Classical Problems lets Galois theory unfold in a natural way, beginning with the geometric construction problems of antiquity, continuing through the construction of regular  $n$ -gons and the properties of roots of unity, and then on to the solvability of polynomial equations by radicals and beyond. The logical pathway is historic, but the terminology is consistent with modern treatments. No previous knowledge of algebra is assumed. Notable topics treated along this route include the transcendence of  $e$  and  $\pi$ , cyclotomic polynomials, polynomials over the integers, Hilbert's irreducibility theorem, and many other gems in classical mathematics. Historical and bibliographical notes complement

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the text, and complete solutions are provided to all problems.

### **Classical Field Theory**

Translated from the 6th Russian edition, this latest edition contains seven new sections with chapters on General Relativity, Gravitational Waves and Relativistic Cosmology, where Professor Lifshitz's interests lay. The text of the 3rd English edition has been thoroughly revised and additional problems inserted

### **Special Relativity and Classical Field Theory**

Decoherence, a concept known only to few physicists when the first edition appeared in 1996, has since become firmly established experimentally and understood theoretically, as well as widely reported in the literature. The major consequences of decoherence are the emergence of "classicality" in general, superselection rules, the border line between microscopic and macroscopic behavior in molecules and field theory, the emergence of classical spacetime, and the appearance of quantum jumps. The most important new developments in this rapidly evolving field are included in the second edition of this book, which has become a standard reference on the subject. All chapters have been thoroughly revised and updated. New fields of application now addressed span chaos theory,

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quantum information, neuroscience, primordial fluctuations in cosmology, black holes and string theory, experimental tests, and interpretational issues. While the major part of the book is concerned with environmental decoherence derived from a universal Schrödinger equation, later chapters address related or competing methods, such as consistent histories, open system dynamics, algebraic approaches, and collapse models.

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