

Electrodynamics

Lecture 1



Basic Information

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17:30-18:15

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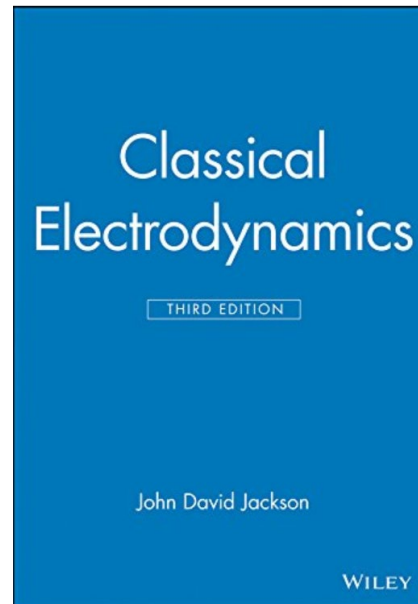
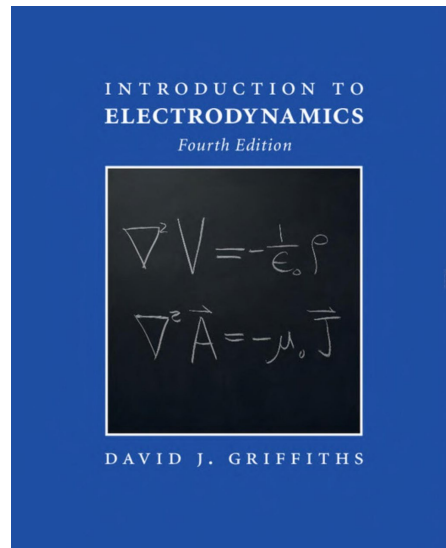
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Textbook and Assessments

Textbook and References

Textbook: *Introduction to Electrodynamics*, 4th Edition, by David J. Griffiths, Cambridge University Press

Reference: *Classical Electrodynamics*, 3rd Edition, by John D. Jackson, Higher Education Press.



Textbook and Assessments



参考书 Jackson - Classical Electrodynamics 3rd edit.pdf



参考书 Zangwill A. Modern electrodynamics_.pdf



参考书 郭硕鸿《电动力学》第三版.pdf



参考资料 Mathematical Preliminaries.pdf



讲义 Electrodynamics Chapter 2.pdf



讲义 Electrodynamics Chapter 1 Mathematical Prelim.pdf



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Textbook and Assessments

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Textbook: *Introduction to Electrodynamics*, 4th Edition, by David J. Griffiths, Cambridge University Press

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Assessments

Home Exercises 20% → 40%

Midterm written exam 20% → 0%

Final written exam 60%



Course Description

Electrodynamics is a fundamental course in physics and aims to provide undergraduate students with an introduction to the principles and behaviors of dynamical electric and magnetic systems.

The main contents include

1. Mathematical preliminaries: Vectors analysis, Laplace's equation, generalized functions, orthogonal transformations, Cartesian tensors, Helmholtz theorem.
2. Electrostatics: Gauss's Law, the method of images, separation of variables, multipole expansion, polarization, linear dielectrics.
3. Magnetostatics: Lorentz force, Biot-Savart law, magnetic vector potential, magnetization, magnetic susceptibility and permeability.
4. Maxwell's Equations: electromotive force, electromagnetic induction, differential and integral forms of Maxwell's equations, boundary conditions, continuity equation, Poynting's theorem, Maxwell's stress tensor.



Course Description

Electrodynamics is a fundamental course in physics and aims to provide undergraduate students with an introduction to the principles and behaviors of dynamical electric and magnetic systems.

The main contents include

5. Electromagnetic waves: waves in a medium, reflection and transmission, absorption and dispersion, guided waves.
6. Potentials and fields: scalar and vector potential, Gauge transformations, retarded potentials, Jefimenko's equations, Lienard-Wiechert potentials.
7. Radiation: electric and magnetic dipole radiation, radiation of point charges.
8. Electrodynamics and relativity: special theory of relativity, Galilean and Lorentz transformations, four-vectors and field tensor, covariant form of Maxwell equations.
9. Numerical solutions of the time-dependent Maxwell equations: Finite-difference Time-domain Method.



Book: *Introduction to Electrodynamics*

1. Vector analysis
2. Electrostatics
3. Potentials
4. Electric fields in matter
5. Magnetostatics
6. Magnetic fields in matter
7. Electrodynamics
8. Conservation laws
9. Electromagnetic waves
10. Potentials and fields
11. Radiation
12. Electrodynamics and relativity

Mathematical preliminaries

Appendix: Numerical solutions of the time-dependent Maxwell equations

Book: *Introduction to Electrodynamics*

Contents

Preface	xii
Advertisement	xiv
1 ■ Vector Analysis	1
1.1 Vector Algebra 1	
1.1.1 Vector Operations 1	
1.1.2 Vector Algebra: Component Form 4	
1.1.3 Triple Products 7	
1.1.4 Position, Displacement, and Separation Vectors 8	
1.1.5 How Vectors Transform 10	
1.2 Differential Calculus 13	
1.2.1 “Ordinary” Derivatives 13	
1.2.2 Gradient 13	
1.2.3 The Del Operator 16	
1.2.4 The Divergence 17	
1.2.5 The Curl 18	
1.2.6 Product Rules 20	
1.2.7 Second Derivatives 22	
1.3 Integral Calculus 24	
1.3.1 Line, Surface, and Volume Integrals 24	
1.3.2 The Fundamental Theorem of Calculus 29	
1.3.3 The Fundamental Theorem for Gradients 29	
1.3.4 The Fundamental Theorem for Divergences 31	
1.3.5 The Fundamental Theorem for Curls 34	
1.3.6 Integration by Parts 36	
1.4 Curvilinear Coordinates 38	
1.4.1 Spherical Coordinates 38	
1.4.2 Cylindrical Coordinates 43	
1.5 The Dirac Delta Function 45	
1.5.1 The Divergence of \hat{r}/r^2 45	
1.5.2 The One-Dimensional Dirac Delta Function 46	
1.5.3 The Three-Dimensional Delta Function 50	

Contents

1.6 The Theory of Vector Fields 52	
1.6.1 The Helmholtz Theorem 52	
1.6.2 Potentials 53	
2 ■ Electrostatics	59
2.1 The Electric Field 59	
2.1.1 Introduction 59	
2.1.2 Coulomb’s Law 60	
2.1.3 The Electric Field 61	
2.1.4 Continuous Charge Distributions 63	
2.2 Divergence and Curl of Electrostatic Fields 66	
2.2.1 Field Lines, Flux, and Gauss’s Law 66	
2.2.2 The Divergence of \mathbf{E} 71	
2.2.3 Applications of Gauss’s Law 71	
2.2.4 The Curl of \mathbf{E} 77	
2.3 Electric Potential 78	
2.3.1 Introduction to Potential 78	
2.3.2 Comments on Potential 80	
2.3.3 Poisson’s Equation and Laplace’s Equation 83	
2.3.4 The Potential of a Localized Charge Distribution 84	
2.3.5 Boundary Conditions 88	
2.4 Work and Energy in Electrostatics 91	
2.4.1 The Work It Takes to Move a Charge 91	
2.4.2 The Energy of a Point Charge Distribution 92	
2.4.3 The Energy of a Continuous Charge Distribution 94	
2.4.4 Comments on Electrostatic Energy 96	
2.5 Conductors 97	
2.5.1 Basic Properties 97	
2.5.2 Induced Charges 99	
2.5.3 Surface Charge and the Force on a Conductor 103	
2.5.4 Capacitors 105	
3 ■ Potentials	113
3.1 Laplace’s Equation 113	
3.1.1 Introduction 113	
3.1.2 Laplace’s Equation in One Dimension 114	
3.1.3 Laplace’s Equation in Two Dimensions 115	
3.1.4 Laplace’s Equation in Three Dimensions 117	
3.1.5 Boundary Conditions and Uniqueness Theorems 119	
3.1.6 Conductors and the Second Uniqueness Theorem 121	

Contents

3.2 The Method of Images 124	
3.2.1 The Classic Image Problem 124	
3.2.2 Induced Surface Charge 125	
3.2.3 Force and Energy 126	
3.2.4 Other Image Problems 127	
3.3 Separation of Variables 130	
3.3.1 Cartesian Coordinates 131	
3.3.2 Spherical Coordinates 141	
3.4 Multipole Expansion 151	
3.4.1 Approximate Potentials at Large Distances 151	
3.4.2 The Monopole and Dipole Terms 154	
3.4.3 Origin of Coordinates in Multipole Expansions 157	
3.4.4 The Electric Field of a Dipole 158	
4 ■ Electric Fields in Matter	167
4.1 Polarization 167	
4.1.1 Dielectrics 167	
4.1.2 Induced Dipoles 167	
4.1.3 Alignment of Polar Molecules 170	
4.1.4 Polarization 172	
4.2 The Field of a Polarized Object 173	
4.2.1 Bound Charges 173	
4.2.2 Physical Interpretation of Bound Charges 176	
4.2.3 The Field Inside a Dielectric 179	
4.3 The Electric Displacement 181	
4.3.1 Gauss’s Law in the Presence of Dielectrics 181	
4.3.2 A Deceptive Parallel 184	
4.3.3 Boundary Conditions 185	
4.4 Linear Dielectrics 185	
4.4.1 Susceptibility, Permittivity, Dielectric Constant 185	
4.4.2 Boundary Value Problems with Linear Dielectrics 192	
4.4.3 Energy in Dielectric Systems 197	
4.4.4 Forces on Dielectrics 202	
5 ■ Magnetostatics	210
5.1 The Lorentz Force Law 210	
5.1.1 Magnetic Fields 210	
5.1.2 Magnetic Forces 212	
5.1.3 Currents 216	
5.2 The Biot-Savart Law 223	
5.2.1 Steady Currents 223	
5.2.2 The Magnetic Field of a Steady Current 224	

vii

Book: *Introduction to Electrodynamics*

Contents

5.3	The Divergence and Curl of \mathbf{B}	229
5.3.1	Straight-Line Currents	229
5.3.2	The Divergence and Curl of \mathbf{B}	231
5.3.3	Ampère's Law	233
5.3.4	Comparison of Magnetostatics and Electrostatics	241
5.4	Magnetic Vector Potential	243
5.4.1	The Vector Potential	243
5.4.2	Boundary Conditions	249
5.4.3	Multipole Expansion of the Vector Potential	252

6 ■ Magnetic Fields in Matter 266

6.1	Magnetization	266
6.1.1	Diamagnets, Paramagnets, Ferromagnets	266
6.1.2	Torques and Forces on Magnetic Dipoles	266
6.1.3	Effect of a Magnetic Field on Atomic Orbits	271
6.1.4	Magnetization	273
6.2	The Field of a Magnetized Object	274
6.2.1	Bound Currents	274
6.2.2	Physical Interpretation of Bound Currents	277
6.2.3	The Magnetic Field Inside Matter	279
6.3	The Auxiliary Field \mathbf{H}	279
6.3.1	Ampère's Law in Magnetized Materials	279
6.3.2	A Deceptive Parallel	283
6.3.3	Boundary Conditions	284
6.4	Linear and Nonlinear Media	284
6.4.1	Magnetic Susceptibility and Permeability	284
6.4.2	Ferromagnetism	288

7 ■ Electrodynamics 296

7.1	Electromotive Force	296
7.1.1	Ohm's Law	296
7.1.2	Electromotive Force	303
7.1.3	Motional emf	305
7.2	Electromagnetic Induction	312
7.2.1	Faraday's Law	312
7.2.2	The Induced Electric Field	317
7.2.3	Inductance	321
7.2.4	Energy in Magnetic Fields	328
7.3	Maxwell's Equations	332
7.3.1	Electrodynamics Before Maxwell	332
7.3.2	How Maxwell Fixed Ampère's Law	334
7.3.3	Maxwell's Equations	337

Contents

7.3.4	Magnetic Charge	338
7.3.5	Maxwell's Equations in Matter	340
7.3.6	Boundary Conditions	342

8 ■ Conservation Laws 356

8.1	Charge and Energy	356
8.1.1	The Continuity Equation	356
8.1.2	Poynting's Theorem	357
8.2	Momentum	360
8.2.1	Newton's Third Law in Electrodynamics	360
8.2.2	Maxwell's Stress Tensor	362
8.2.3	Conservation of Momentum	366
8.2.4	Angular Momentum	370
8.3	Magnetic Forces Do No Work	373

9 ■ Electromagnetic Waves 382

9.1	Waves in One Dimension	382
9.1.1	The Wave Equation	382
9.1.2	Sinusoidal Waves	385
9.1.3	Boundary Conditions: Reflection and Transmission	388
9.1.4	Polarization	391
9.2	Electromagnetic Waves in Vacuum	393
9.2.1	The Wave Equation for \mathbf{E} and \mathbf{B}	393
9.2.2	Monochromatic Plane Waves	394
9.2.3	Energy and Momentum in Electromagnetic Waves	398
9.3	Electromagnetic Waves in Matter	401
9.3.1	Propagation in Linear Media	401
9.3.2	Reflection and Transmission at Normal Incidence	403
9.3.3	Reflection and Transmission at Oblique Incidence	405
9.4	Absorption and Dispersion	412
9.4.1	Electromagnetic Waves in Conductors	412
9.4.2	Reflection at a Conducting Surface	416
9.4.3	The Frequency Dependence of Permittivity	417
9.5	Guided Waves	425
9.5.1	Wave Guides	425
9.5.2	TE Waves in a Rectangular Wave Guide	428
9.5.3	The Coaxial Transmission Line	431

10 ■ Potentials and Fields 436

10.1	The Potential Formulation	436
10.1.1	Scalar and Vector Potentials	436
10.1.2	Gauge Transformations	439

ix

Contents

10.1.3	Coulomb Gauge and Lorenz Gauge	440
10.1.4	Lorentz Force Law in Potential Form	442
10.2	Continuous Distributions	444
10.2.1	Retarded Potentials	444
10.2.2	Jefimenko's Equations	449
10.3	Point Charges	451
10.3.1	Liénard-Wiechert Potentials	451
10.3.2	The Fields of a Moving Point Charge	456

11 ■ Radiation 466

11.1	Dipole Radiation	466
11.1.1	What is Radiation?	466
11.1.2	Electric Dipole Radiation	467
11.1.3	Magnetic Dipole Radiation	473
11.1.4	Radiation from an Arbitrary Source	477
11.2	Point Charges	482
11.2.1	Power Radiated by a Point Charge	482
11.2.2	Radiation Reaction	488
11.2.3	The Mechanism Responsible for the Radiation Reaction	492

12 ■ Electrodynamics and Relativity 502

12.1	The Special Theory of Relativity	502
12.1.1	Einstein's Postulates	502
12.1.2	The Geometry of Relativity	508
12.1.3	The Lorentz Transformations	519
12.1.4	The Structure of Spacetime	525
12.2	Relativistic Mechanics	532
12.2.1	Proper Time and Proper Velocity	532
12.2.2	Relativistic Energy and Momentum	535
12.2.3	Relativistic Kinematics	537
12.2.4	Relativistic Dynamics	542
12.3	Relativistic Electrodynamics	550
12.3.1	Magnetism as a Relativistic Phenomenon	550
12.3.2	How the Fields Transform	553
12.3.3	The Field Tensor	562
12.3.4	Electrodynamics in Tensor Notation	565
12.3.5	Relativistic Potentials	569

A ■ Vector Calculus in Curvilinear Coordinates 575

A.1	Introduction	575
A.2	Notation	575



Learning Outcomes

By the end of the course, the student must be able to:

- Describe Maxwell equations and its physical consequences
- Formalize physical problems into mathematical equations
- Formulate the basic consequences of special relativity
- Specific electrodynamic phenomena into precise mathematical language
- Describe physical phenomena in the language of fields and particles
- Solve mathematical equations analytically and/or numerically
- Solve Time-Dependent Maxwell equations numerically



Proper Learning

1. Read the book: make sure you read all contents carefully and completely.
2. Follow the lectures: make sure you understand all the contents discussed in the class.
3. Finish the excises: hand in your homework on time.
4. Enjoy the study.



Four Kinds of Forces

1. Strong
2. Electromagnetic
3. Weak
4. Gravitational



Electromagnetic Forces

Where is friction?

Where is the "normal" force that keeps you from falling through the floor?

Where are the chemical forces that bind molecules together?

Where is the force of impact between two colliding billiard balls?

The answer is that *all* these forces are *electromagnetic*.

Indeed, it is scarcely an exaggeration to say that we live in an electromagnetic world virtually every force we experience in everyday life, with the exception of gravity, is electromagnetic in origin.