Electrodynamics

Lecture 1

Basic Information

Lecturer: Prof. Shengjun Yuan 袁声军
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Teaching Assistant: Dr. Zhen Zhan 詹真

Online Teaching Hours: Monday and Friday
16:40-17:25
17:30-18:15

Online Teaching Group: QQ 1037712987

We will use also the Tencent online teaching system 腾讯课堂

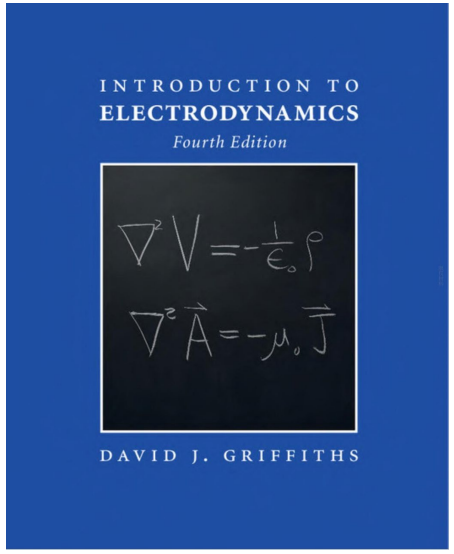
Please download and install the student version in PC or mobile phone at
https://ke.qq.com/s

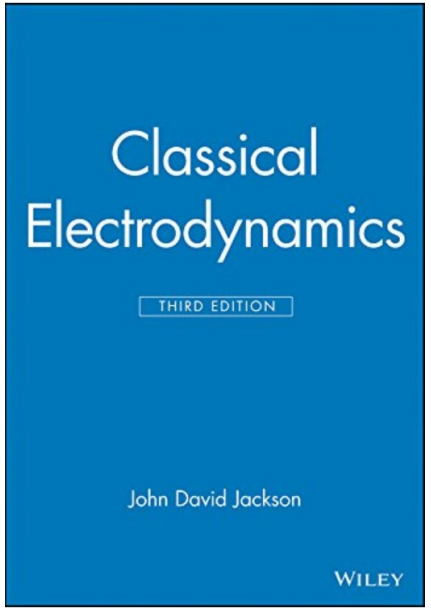
Textbook and Assessments

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


教材 Griffiths-Electrodynamics-4ed.pdf


教材目录 Griffiths-Electrodynamics-4ed Contents.pdf


教材索引 Griffiths-Electrodynamics-4ed Index.pdf


《电动力学》课程教学大纲 英文.pdf

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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.

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5. Electromagnetic waves: waves in a medium, reflection and transmission, absorption and dispersion, guided waves.
6. Potentials and fields: scale and vector potential, Gauge transformations, retarded potentials, Jefimenko's equations, Lienard-Wiechert potentials.
7. Radiation: electronic 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 — Mathematical preliminaries
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

Appendix: Numerical solutions of the time-dependent Maxwell equations

Book: *Introduction to Electrodynamics*

Contents

Book: *Introduction to Electrodynamics*

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.