This is a tentative schedule of what we will cover in the course. It is subject to change, often without notice. These will occur in response to the speed with which we cover material, individual class interests, and possible changes in the topics covered. Use this plan to read ahead from the lecture notes and following textbooks, so you are better equipped to ask questions in class.

2. J.D. Jackson “Classical Electrodynamics” 3rd edition

Special Relativity with basics of relativistic Field Theory

- PRELIMINARIES


Suggested literature: Lecture notes
Secs.1.2.1-1.2.4,1.7 in [3]
Secs. 4.1-4.6 in [4]


Suggested literature: Lecture notes
Secs. 1.2.5,1.8 in [3]
Secs. 4.7,4.8 in [4]


Suggested literature: Lecture notes
Sec.22.2 in [3]
• KINEMATICS OF SPECIAL RELATIVITY


Suggested literature: Lecture notes

$\S$§1-3 in [1]
Sec. 11.1 in [2]
Sec.22.3 in [3]
Sec.7.1 in [4]

Lorentz group: Definition. Parity and time reversal transformations. Proper, improper, orthochronous, non-orthochronous Lorentz transformations. General structure of the Lorentz group. Lorentz boosts. Group of proper, orthochronous Lorentz transformations $SO^+(1, 3)$.

Suggested literature: Lecture notes

$\S$§4,5 in [1]
Sec.11.2 in [2]
Sec.22.4 in [3]


Suggested literature: Lecture notes

$\S$§6,7 in [1]
Secs.11.3,11.4,11.6 in [2]
Secs.22.5.1,22.5.2 in [3]

Matrix representations of the Lorentz group: Rank 2 antisymmetric tensor. Quadratic invariants. Finite dimensional irreducible representations of $SO^+(1, 3)$, $O^+(1, 3)$ and $O(1, 3)$.

Suggested literature: Lecture notes

• COVARIANT FORM OF MAXWELL’S EQUATIONS

First pair of Maxwell’s eqs.: Fields. Field-strength tensor. Covariant form(s) of the first pair of Maxwell’s eqs.

Suggested literature: Lecture notes

$\S$§23-26 in [1]
Secs.11.9,11.10 in [2]


Suggested literature: Lecture notes

$\S$§23-25 in [1]
Secs.1.3,1.4,5.1-5.3,5.15.6.1,6.11.6.12 in [2]
Secs.1.4.2,1.2.2 in [3]

Second pair of Maxwell’s eqs.: Covariant form. 4-current. The continuity equation.

Suggested literature: Lecture notes

$\S$§28-30 in [1]
Sec.1.5 in [3]


Suggested literature: Lecture notes

Sec.1.9 in [3]

Suggested literature: Lecture notes
§18 in [1]
Secs.6.2.6.3 in [2]
Secs.15.3 in [3]

• VARIATIONAL PRINCIPLE

Poisson’s equation in curvilinear coordinates: Variational principle for Poisson’s equation. Laplacian in curvilinear coordinates. Orthogonal coordinates.
Suggested literature: Lecture notes
Secs.1.7-1.12 in [2]

Suggested literature: Lecture notes
§§27,30,32 in [1]
Sec.12.7 in [2]
Secs.13.1,13.2 in [4]

Suggested literature: Lecture notes
§§81-83,90 in [1]

Suggested literature: Lecture notes
§§8,9,15 – 17 in [1]
Secs.6.7,12.1 in [2]
Secs.7,9,7,10 in [4]

• CONSERVATION LAWS

Symmetries: Continuous and discrete symmetries of Classical Electrodynamics. Noether’s theorem.
Suggested literature: Lecture notes
Sec.6.10 in [2]
Secs.15.1,15.2,24.4.2 in [3]
Sec.13.7 in [4]

Suggested literature: Lecture notes
§§32,33,94 in [1]
Secs.6.7,12.10 in [2]
Secs.13.3,13.5,13.6 in [4]
Rotational invariance and angular momentum: 4-tensor of angular momentum. The center-of-energy theorem. Pauli-Lubanski 4-vector.

Suggested literature: Lecture notes
§§14, 32 in [1]
Secs.15.6,15.7 in [3]

Applications of Classical Electrodynamics

• MAGNETOSTATICS


Suggested literature: Lecture notes
§§43,44 in [1]
Sec.5.3-5.6 in [2]
Secs.11.1,11.2 in [3]

Macroscopic equations: Magnetization. The magnetic field (intensity). Boundary conditions. Relation between magnetic (field) induction and magnetic field (intensity). Methods of solving boundary value problems in magnetostatic.

Suggested literature: Lecture notes
Sec.5.8-5.13 in [2]


Suggested literature: Lecture notes
§§45 in [1]
Sec.5.7 in [2]

• QUASI-STATIC FIELDS


Suggested literature: Lecture notes
Sec.5.16,5.17 in [2]


Suggested literature: Lecture notes
Sec.6.3.5.18 in [2]
Secs.14.5-14.7, 14.10 in [3]

• ELECTROMAGNETIC WAVES

Waves in vacuum:
Waves in simple matter:
Waves in dispersive matter:

• RETARDATION AND RADIATION