Jimma University College of Natural Sciences Department of Physics
Course Outline for Electrodynamics II

Course Title: Electrodynamics II **Course Credits:** 3**,** ECTS: 5

Code: Phys 3082 **weeks required:** 16

Mode of delivery: Full semester **Year/semester**:III/II

Prerequisite(s) for enrollment: None

Course Rationale

This course is mainly intended to introduce potential formulation for solving electrodynamical problems. It also emphasizes on the electric and magnetic fields produced by moving charges where special attention is given to radiating systems. The procedure in which potentials are used instead of fields lays concrete foundation for relating electrodynamics with relativity that leads to covariant formulation of electrodynamics.

Learning Outcomes

At the end of the course the student will be able to:

• extend the concepts in Phys 376 to none quasi-static limit,

• apply Maxwell's equation to variety of physical systems,

• describe electromagnetic phenomena with the aid of potentials,

• demonstrate understanding how electric potential and fields transform,

• solve problems applying potential formalism and understand that the results are independent of the approaches one used,

• demonstrate understanding of the process of electromagnetic radiation,

• relate electrodynamics with relativity.

Course Description

The main topics are: Maxwell's Equations and their Empirical Basis, Lorentz Condition, Lienard-Wiechert Potentials, Lorentz Transformation of Electric and Magnetic Fields, Fields of Uniformly Moving Charge, Motion of Point Charge in an Electromagnetic Field, Power Radiated by Accelerated Point Charge, Bremsstrahlung, Thomson Scattering, Electric Dipole Radiation, Covariant Formulation of Electrodynamics

Method of Teaching

Lecture, discussion, homework, tutorial and project, online learning resources are also employed.

Tentative Time Breakdown of Lecture Topics

Maxwell's Equations

- Electrodynamics before Maxwell's
- How Maxwell fix Ampere's law
- Maxwell's equations
- Magnetic charge
- Maxwell's equation in matter
- Boundary conditions

Conservation Laws

- Charge and energy
- Conservation of momentum
- Newtons law in electrodynamics

Potential and Fields

- Potential formulation
- Coulombs and Lorentzs gauges
- Continuous charge distributions
- Retarded potentials
- Jefimenkos equations
- Lienard-Wiecherts potentials
- Field of moving point Charge

Radiation

- ✓ Electric dipole radiation
- ✓ Magnetic dipole radiation
- ✓ Radiation from arbitrary source
- ✓ Power radiated by point charge
- ✓ Radiation reaction
- ✓ Physical basis of radiation reaction
- ✓ Bremsstrahlung

Covariant Formulation of Electrodynamics

- Magnetism as relativistic phenomena
- Field transformation
- Electromagnetic field tensor
- Covariant formulation
- of Electrodynamics
- Relativistic potentials

Assessment

No	Type ofAssessment	Time	Weight
1	Test I	Week 4	10%
	Test II	Week 12	10%
2	Assignment I	Week 2	10%
	Assignment II	Week 8	10%
3	Class activity and home work	All week	10%
4	Final exam	Final week	50%
Total			100%

Recommended References

Course Textbook

Munir H. Nayfeh, *Electricity and Magnetism*, Banjamin Cummings, 3rd ed., 1999.

References

- David J. Griffiths, *Introduction to electrodynamics*, 3rs ed., 1999.
- Hugh D. Young and Roger A. Freedmann, *University Physics with Modern Physics* 12th ed., 2008
- Douglas C. Giancoli, *Physics for scientists and engineers*, Printice Hall, 4th, 2005
- Robert Resnick and David Halliday, *Fundamentals of Physics Extended*, HRW 8th ed., 2008
- Paul M. Fishbane, Stephene Gasiorowicz, Stephen T. Thoronton, *Physics for Scientists and Engineers*, 3rd ed., 2005