

Electrodynamics II

Module Code: Phys-M3081;	EtCTS of Course: 5 ;	Course Status:	Compulsory
Course Title :	Electrodynamics II		
Course Code:	Phys3082;	Credits Hours:	3
Mode of delivery:	Full Semester;	Weeks required:	16
Prerequisite(s):		Co-requisite(s):	
Academic Year:	20____/____ ;	Year/Semester:	III/ II
Students' College/Faculty:	_____;	Department:	Physics
Program:	Undergraduate	Enrollment:	_____
Instructor's Name (Coordinator)	_____		
Address: Email:	_____	Block No. _____;	Rm. No. _____
Class Hours:	_____		

Course Rationale

This course is mainly intended to introduce potential formulation for solving electrodynamic 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.

Course Outline: EtCTS (5)

No	Topic	Lecture (hrs)	Tutor (hrs)	Home (hrs)	T.Load (hrs)
1)	Maxwell's Equations	8	3	13	24
2)	Conservation Laws	6	2	10	18
3)	Potential and Fields	13	4	20	37
4)	Radiation	13	4	20	37
5)	Covariant Formulation of Electrodynamics	5	2	12	19
	Total	45	15	75	135

Method of Teaching

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

Tentative Time Breakdown of Lecture Topics

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 1	Maxwell's Equations • Electrodynamics before Maxwell's • How Maxwell fix Ampere's law	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 2	• Maxwell's equations • Magnetic charge • Maxwells equation in matter			
Assignment I				
Week 3	• Boundary conditions Conservation Laws • Charge and energy	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 4	• Conservation of momentum • Newtons law in electro-dynamics			
Test I				
Week 5	Potential and Fields • Potential formulation • Coulombs and Lorentzs gauges	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 6	• Continuous charge distributions • Retarded potentials			

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 7	<ul style="list-style-type: none"> Jefimenkos equations Lienard-Wiecherts potentials 	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 8	<ul style="list-style-type: none"> Field of moving point charge 			
Assignment II				
Week 9	Radiation <ul style="list-style-type: none"> Electric dipole radiation Magnetic dipole radiation 	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 10	<ul style="list-style-type: none"> Radiation from arbitrary source Power radiated by point charge 			
Week 11	<ul style="list-style-type: none"> Radiation reaction 			
Week 12	<ul style="list-style-type: none"> Physical basis of radiation reaction Brerassstrahlung 			
Test II				
Week 13	Covariant Formulation of Electrodynamics <ul style="list-style-type: none"> Magnetism as relativistic phenomena Field transformation 	Gapped Lecture, Group discussion, Active learning method	Lecturing, Leading discussions, Asking and answering questions, Preparing home works, reading assignments and feedback	Listen to a lesson, take short notes, asking and answering questions, Doing home work reading assignments, Presentation
Week 14	<ul style="list-style-type: none"> Electromagnetic field tensor Covariant formulation of Electrodynamics Relativistic potentials 			
Week 15	Revision and Self Study			
Week 16	Final Exam			

Assessment

No	Type of Assessment	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 weeks	10%
4	Final exam	Final week	50%
		Total	100%

COURSE PROGRESS EVALUATION FOCUS

Course evaluation will be through feedback received from students in the lecture, tutorial programmes and test results and through an anonymous student survey which should be conducted every month.

KEY STUDENT-RELATED POLICIES

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and work in team.

Recommended References

Course Textbook

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

References

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