



SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Language
PHY	321	Electromagnetic Fields	3	2	0	2	5	PHY 220, MAT 203	5	English

A. Course Description

This course provides the most fundamental concepts of the laws of electromagnetism and their physical characteristics in dielectric and conductive media. It deals with static electric and magnetic fields as well as the properties of conducting dielectric and magnetic materials. It covers the following topics: electrostatics, behavior of matter in electric fields, DC circuits, magnetic fields, and properties of dielectrics and magnetic materials. Faraday's law, AC circuits, and electromagnetic waves. More mathematical techniques are also given using Laplace's, Poisson, Lorentz, Biot-Savart etc. in different dimensions and with boundary conditions to calculate the field more accurately in space and time. Finally it deals with the 4 major Maxwell's equations.

B. Course Outcomes

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

1. Understand the basic concepts of electric and magnetic fields.
2. Apply various techniques to electrostatic problems.
3. Knowledge of the properties of the electric fields in matter.
4. Understand the magnetic properties of simple current distributions using Biot-Savart and Ampere's laws.
5. Describe electromagnetic induction and related concepts, and make calculations using Faraday and Lenz's laws.
6. Include the basic physical content of Maxwell's laws in integral form.

C. References

Required Textbook

Sadiku M., *Elements of Electromagnetic*, 2nd Edition, Saunders College (1995).

Other references

- Nayfeh M.H., and Brussel M.K, *Electricity and Magnetism*, John-Wiley & Sons, New York (1985).
- Griffiths D. J., *Introduction to Electrodynamics*, 3rd Edition, Prentice Hall, N. J, USA (1999).

Course Website: <http://www.imamm.org/>

D. Topics Outline

1. **Vector Analysis:** Scalar product, vector product, Cartesian coordinates, circular cylindrical coordinates, spherical coordinates, vector position and differential element in length, fields, directional derivative and gradient, line integral, surface integral, divergence of a vector, divergence theorem, curl of a vector, Stockes' theorem, conservative fields, Laplacian of a scalar (Contact hours: 12).
2. **Electrostatic Fields:** Coulomb's law and field intensity, electric fields due to continuous charges distributions, electric flux density, Gauss's law-Maxwell's equation, electric potential, relationship between E and V -Maxwell's equation, electric dipole and flux lines, energy density in electrostatic fields (Contact hours: 14).



3. **Electric Fields in Matter:** Properties in materials, conductors, polarization in dielectrics, dielectrics constant and strength (Contact hours: 8).
4. **Magnetic Fields in Matter:** Biot-Savart's Law, Ampere's circuit Law-Maxwell's equation, Maxwell's equations for static electromagnetic field, magnetic dipole, magnetization in materials, classification of magnetic materials, magnetic energy (Contact hours: 12).
5. **Maxwell's Equations and Electromagnetic Wave Propagation:** Faraday's law, displacement current, Maxwell's equations in final forms, time-harmonic fields, waves in general, wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane waves in free space, plane waves in good conductors, power and the Poynting vector, reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence (Contact hours: 14).

E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6th or 7th week.
- **Midterm 2:** 11th or 12th week.
- **Quizzes & Homeworks:** During the semester.
- **Final Exam:** 16th week.

Your course grade will be based on your semester work as follows:

Midterm 1: 20 %	Midterm 2: 20 %	Final Exam: 40 %
Quizzes, Homework, Attendance & Participation: 20 %		

The grading distribution:

A⁺	A	B⁺	B	C⁺	C	D⁺	D	F
[95, 100]	[90, 95]	[85, 90]	[80, 85]	[75, 80]	[70, 75]	[65, 70]	[60, 65]	[0, 60]



G. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. (“Immediate family” is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Exams](#)

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