Lebanese American University

School of Engineering & Architecture

Course Title: Electromagnetic fields. Required: ELE program, Elective: COE program

Department of Electrical and Computer Engineering

Hours: TTH 09:30 - 11:00

Course syllabus

Instructor: Dr. Chadi Abou-Rjeily

1. Course Description

Fundamental concepts of the electromagnetic model, vector analysis, static electric fields, static magnetic fields, steady electric currents, Maxwell’s equations, Coulomb’s law, Gauss’s law, Biot-Savart law, Faraday’s law, Poisson’s and Laplace’s equations, Joule’s law, capacitance calculations, inductance calculations, resistance calculations.

Prerequisite PHY201.

2. Course Objectives

The objective of the course is to introduce students to the basics of electromagnetic fields emphasizing on the solution of electrostatic and magnetostatic problems.

A student who has successfully completed this course should be able to:
1. understand the basics of the electromagnetic model.
2. apply tools from vector algebra and vector calculus for solving electromagnetic problems.
3. understand the postulates of electrostatics in both differential and integral forms.
4. determine the electric field intensity by applying Coulomb’s law and Gauss’s law.
5. understand the behavior of electric fields in free space and in material media.
6. apply Poisson’s and Laplace’s equation for solving electrostatic problems subject to boundary conditions.
7. understand the basic rules governing the behavior of free electric charges at motion.
8. understand and apply Kirchhoff’s current and voltage laws.
9. understand the postulates of magnetostatics in both differential and integral forms.
10. determine the magnetic flux density by applying Biot-Savart law and Ampere’s law.
11. solve basic magnetic-circuits problems.
12. understand the behavior of magnetic materials.
13. understand Faraday’s law and the principle of electromagnetic induction.
14. understand Maxwell’s equations in both differential form and integral forms.
15. understand the behavior of time-harmonic fields.

3. Contribution of course to meeting the professional component

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<tr>
<th>Professional Component</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Mathematics and Basic Sciences</td>
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<tr>
<td>Engineering Topic</td>
<td>3</td>
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<tr>
<td>General Education</td>
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4. Relationship of course to program outcomes

PO (a): an ability to apply knowledge of mathematics, science, and engineering
- Applies knowledge of electrical circuits

PO (e): an ability to define, formulate, and solve engineering problems
- Demonstrates an ability to formulate engineering problems, to recognize and identify the basic governing theories and principles in the area of electrical circuits

5. Course Outline

Vector Analysis
- Dot product and cross product
- Orthogonal coordinate systems
- Gradient of a scalar
- Divergence of a vector
- Curl of a vector
- Divergence theorem
Stokes's theorem
Helmholtz’s theorem

**Static Electric Fields**
Coulomb’s law
Gauss’s law
Electric potential
Conductors and dielectrics in electrostatic fields
Electric flux density
Boundary conditions for electrostatic fields
Capacitance and capacitors
Electrostatic energy
Electrostatic forces
Poisson’s and Laplace’s equations
Method of images

**Steady Electric Currents**
Ohm’s law
Kirchhoff’s law
Joule’s law
Boundary conditions for current density
Resistance calculations

**Static Magnetic Fields**
Ampere’s law
Biot-Savart law
Magnetic field intensity
Magnetic circuits
Boundary conditions for magnetostatic fields
Inductance and inductors
Magnetic energy
Magnetic forces

**Time-Varying fields and Maxwell’s equations**
Faraday’s law of electromagnetic induction
Maxwell’s equation
Electromagnetic boundary conditions
Time-harmonic fields

**Introduction to Electromagnetic Waves**

6. **Required tools / software / skills**

N.A.

7. **Textbook[s]**


8. **Additional References**


9. **Schedule of Exams & Grading Percentage**

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<tbody>
<tr>
<td>Quizzes</td>
<td>15%</td>
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<tr>
<td>Mid term 1</td>
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<tr>
<td>Mid term 2</td>
<td>25%</td>
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<tr>
<td>Final Exam</td>
<td>35%</td>
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10. **Course Policies**
• Failure to take a test or the final exam during the assigned class period will result in a grade of zero being recorded for that test unless the student has personally contacted me and received permission to be absent from the test.
• No makeup exams will be given for the two midterms. In case a student fails to take an exam, the 25% of the final grade assigned for this midterm will be redistributed in the following manner: 10% for the other midterm (that will now count for 35% of the final grade) and 15% for the final exam (that will now count for 50% of the final grade).
• Makeup exams will be given for students who fail to attend the final exam.
• The student is responsible for all business conducted and announcements made during any scheduled class period. LAU attendance policies are enforced.

11. General Comments

Homework sets will be given on a regular basis and their solutions will be posted on the course website. Most of the homeworks will be solved in class. Even though homeworks will not be graded, they are critical to learning the material and to doing well on the midterms and final exam. Homework questions will appear regularly in quizzes and they may also appear in the tests. You are encouraged to discuss the homework with your colleagues.

In order to get the most out of the course, try to stay ahead. Before attending a lecture, make sure you have reviewed the material covered in the previous lectures. Read the assigned material, but at a minimum, make sure to review the slides posted on the course website. This way, lectures will be much more informative and meaningful. Studying on a daily basis will be very fruitful since quizzes count for 15% of the final grade.

It is intended that the overall work required be approximately six hours per week, including three hours of lecture. Students who find themselves spending substantially more than six hours any week should question whether they are stuck and might make more rapid progress if they asked the instructing staff for some hints or advice. I am available at these office hours:

Office Hours: TTH 11:00 - 01:00, W 12:00 – 02:00 or by appointment.
Office: Bassil 102.
Email: chadi.abourjeily@lau.edu.lb
Course Website: http://services.sea.lau.edu.lb/academia/courses/ele411/

12. General Rules & Regulations

• A student can miss no more than 4 sessions of instruction. By the 5th session, the instructor may ask the student to drop the course.
• Plagiarism: students caught cheating on an exam receive a grade of zero on the exam in the first cheating attempt and a warning. Students caught cheating for the second time in the same course receive an F grade in the course and a second warning. A grade of zero on an exam resulting from cheating must be counted in the student’s course grade. The zero cannot be dropped in computing the final grade in case the instructor has a policy of allowing students to drop their worst exam grade.
• Any student who receives 3 warnings will be suspended.

13. Person(s) who prepared this description and date of preparation

Chadi Abou-Rjeily, February 15, 2010