Middle East Technical University
Department of Electrical and Electronics Engineering
2020-2021 Spring Semester

EE 224 ELECTROMAGNETIC THEORY

Instructors

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Schedule of the course:

Lecture hours: Monday: 12:40-14:30, Wednesday 12:40-14:30

Instructional methods in on-line education semester:

Lectures will be delivered by the instructor of each section separately. Information about the lecture delivery style of each instructor (synchronous/asynchronous lectures, sharing class notes and/or lecture recordings, etc.) will be given during the first lecture of the corresponding section.

Textbooks

1. *Fundamentals of Engineering Electromagnetics*, David K.Cheng, Pearson New International Ed., 2014 (available at the bookstore), **or**
2. *Field and Wave Electromagnetics*, 2nd Edition, David K.Cheng, Addison-Wesley, 1992.

References

1. *Introductory Engineering Electromagnetics*, Z.D.Popovic, B.D.Popovic, Prentice-Hall, 2000.
2. *Engineering Electromagnetics*, U.S.Inan, A.S.Inan, Addison –Wesley, 1999.
3. *Elements of Electromagnetic***,** M.N.O. Sadiku, Oxford University Press, 2001.
4. *Engineering Electromagnetics,* W. H. Hayt, J. A. Buck, McGraw-Hill, 2006.
5. *Electromagnetic Fields and Waves*, P.Lorrain and D.Corson, Freeman, 1970.
6. *Principles and Applications of Electromagnetic Fields*, R.Plonsey and R.Collin, McGraw-Hill, 1961.
7. *Electromagnetics*, 5th Edition, J.D.Krauss, McGraw –Hill, 1999.
8. *Elements of Engineering Electromagnetics*, N.N.Rao, Prentice-Hall, 2000.
9. *The Feynman Lectures on Physics*, vol.2, R.Feynman, Addison Wesley, 1998.
10. *Vector Analysis*, M.R.Spiegel, Schaum's Outline Series, McGraw-Hill, 2009.

Course Outline

TOPIC	WEEKS	TEXTBOOK 1	TEXTBOOK 2
1. Vector Analysis	3.5 weeks	Chapter 2	Chapter 2
2. Static Electric Fields	4 weeks	Chapter 3	Chapters 3,4
3. Steady Electric Currents	1 week	Chapter 4	Chapter 5
4. Static Magnetic Fields	4 weeks	Chapter 5	Chapter 6
5. Faraday's Law of Induction	1.5 weeks	Chapter 6	Chapter 7

Grading Policy:

Quizes; 15% (Best 3 grades out of 4 quizes)
Midterm Exams: 45% (3 midterm exams, 15% each)
Final Exam: 40%

Midterm exams and the final exam will be proctored by video cameras. Therefore, each student has to have a camera set-up for midterm examinations and the final examination.

Information for Students with Disabilities

Students who experience difficulties due to their disabilities and wish to obtain academic adjustments and/or auxiliary aids must contact ODTU Disability Support Office and/or course instructor and the advisor of students with disabilities at academic departments (for the list:http://engelsiz.metu.edu.tr/en/advisor-students-disabilities) as soon as possible. For detailed information, please visit the website of Disability Support Office: https://engelsiz.metu.edu.tr/en/

EE 224 Topic Details

1. **Vector Analysis**
    a. Vector Algebra (*Addition, Subtraction, Products*)
    b. Orthogonal Coordinate Systems (*Cartesian, Cylindrical, Spherical*)
    c. Vector Calculus
        i. Vector and Scalar Fields
        ii. Gradient of a Scalar Field
        iii. Line/Surface/Volume Integrals
        iv. Divergence and Curl of a Vector Field
        v. Divergence and Stokes' Theorems
        vi. Null Identities
        vii. Helmholtz Theorem

2. **Static Electric Fields**
    a. Coulomb's Law
    b. Gauss Law in Free Space
    c. Electrostatic Potential
    d. Behavior of Conductors in Static Electric Field
    e. Behavior of Dielectrics in Static Electric Field
    f. Polarization and Equivalent Charge Densities
    g. Electric Flux Density and Generalized Gauss Law
    h. Boundary Conditions for Electrostatic Field
    i. Capacitance and Capacitors
    j. Poisson's and Laplace's Equations, 1D Solutions
    k. Electrostatic Energy and Forces, Method of Virtual Displacements
    l. Method of Images

3. **Steady Electric Currents**
    a. Current Density and Types of Current
    b. Equation of Continuity and Kirchhoff's Current Law
    c. Power Dissipation and Joule's Law
    d. Resistance Calculations

4. **Static Magnetic Fields**
    a. Ampere's Force Law
    b. Definition of B Field
    c. Biot-Savart Law and Applications
    d. Vector Magnetic Potential
    e. Ampere's Circuital Law and Applications
    f. Solenoidal Property of B Field, Flux Conservation
    g. Magnetization and Equivalent Current Densities
    h. Magnetic Field Intensity and Generalized Ampere's Circuital Law
    i. Behavior of Magnetic Materials
    j. Boundary Conditions for Magnetostatic Fields
    k. Inductance and Inductors
    l. Magnetic Energy and Forces

5. **Faraday's Law of Electromagnetic Induction**
    a. Lenz' Law
    b. Motional and Transformer EMF's
    c. A Moving Conductor in a Magnetic Field
    d. A Stationary Circuit in Time-Varying Magnetic Field
    e. A Moving Circuit in Time-Varying Magnetic Field