The University of Akron
Department of Electrical Engineering

4400:353	**Electromagnetics I**		Dr. N. Ida
Fall 2018	Location: SCH South 229	MoTuWeFr	Room ASEC-252
	Time 11:45 – 12.35		TEL: 330-972-6525
			e-mail: ida@uakron.edu

TEXT: Engineering Electromagnetics, 3rd Edition, 2015, N. Ida, Springer Verlag.

Office Hours: To be decided by mutual agreement. Suggested times: Monday Wednesday and Friday, 9-11 AM. However, I ask that you come and see me any time (between 7:00 AM and 6:00 PM), regardless of office hours. There will be instances in which I will be busy with other activities. In such cases I ask that you either wait or see me at other times. My telephone number is 972-6525. I will be glad to answer your questions over the phone but it is almost impossible to help with homework assignments over the phone. It is much more likely that we will misunderstand each other than by talking face to face. So please come and see me with any questions you may have. You may also communicate with me by e-mail. My e-mail is ida@uakron.edu.

Course Outline: We will follow the textbook rather closely. The material covered includes chapters 1 and 2 (review only), chapters 3, 4, 5, 7, 8, 9 and 10. The topics are:

Chapter 1 and 2: Review of Vector Algebra and Calculus. (Very short review; < one week)
Chapter 3: Coulomb's Law and the Electric Field
Chapter 4: Gauss' Law and the Electric Potential
Chapter 5: Boundary Value Problems
Chapter 7: The Steady Electric Current
Chapter 8: The Static Magnetic Field
Chapter 9: Magnetic materials and Properties
Chapter 10: Faraday's Law and Induction

Grading:	1st Exam	20%	(Tentative: Monday, October 1)
	2nd Exam	20%	(Tentative: Monday, November 5)
	3rd Exam	20%	(Firm: Tuesday, November 20– see notes)
	Homework	5%	
	Final Exam	35%	(optional, see below)

Note: after the third exam, which will be given on the last week of the Semester, your initial grade will be computed using the following weights:

1st Exam	30%
2nd Exam	35%
3rd Exam	30%
Homework	5%

Notes:

1. The third exam is firm. I will be willing to move it back to any day that same week but will not move it after Thanksgiving week.
2. After the third exam, your initial grade will be computed using **Option B**. You will have this grade before you decide if you need or want to take the final exam.
3. The final exam will be given at the scheduled time. It is your choice to take it or not. If you do, your grade will be calculated based on **Option A**. If you do not take the final exam, your grade will be calculated based on **Option** B. There is no need to tell me of your choice but you are welcome to discuss it with me. The higher grade of the two options will be used. I will take the higher of **Option A** or **Option B** grade as your final grade.
4. The two options are designed so that students that do very well in mid-term exams do not need to take the final while those that did not do well can still improve their grades by taking the final exam.
5. Before each exam, I will make available sample exams. These will be posted on my web site - http://ee.ascs3.uakron.edu/ida/ under the heading Electromagnetics I, for downloading. The number of exams may vary but usually there will be two exams with solutions and one without solutions. The purpose of this third exam is for you to try on your own.
6. Exams are open book, open notes. You can use any material you wish. However, you are not allowed any connected device (no cell phones, laptops, etc.)
7. The textbook for the class is listed above. If you have a previous edition, you may still use that but please be aware that homework will be assigned from the third edition.

Homework: Will be assigned on Mondays (or the first class period we meet) and will be due on Monday (or the first class of the week we meet) of the following week. Homework will be corrected, graded and returned. Solutions to all homework problems will be posted. There will be no homework assigned on thanksgiving week so that you may enjoy the thanksgiving break. I will not accept late homework. Any homework that is not submitted by class time will not be graded.

Supporting material: Additional material (previous exams with solutions, some notes, etc.) will be made available from time to time. This material is optional.

Grader: The grader for this class is not yet known – I will announce that in class. Any questions about grading of homework assignments should be discussed with the grader. However, I will grade all exams so any questions about exams should be addressed to me.

Software: If you go to my website you will find two software programs you may download. You should download the first one (Electromagnetic Simulations) and use it throughout the semester. It deals with simulations to many of the issues we will study and may help in understanding. The second program (The Smith Chart) as well as parts of the first program deal with E&M II issues and will only be useful during the Spring Semester. The programs are written in Matlab.

The following is a detailed outline of the material covered.

Lecture 1. Introduction, vectors, scalars, sum and difference of vectors, products, scaling of vectors, scalar products

Lecture 2. Scalar and vector products, tropple scalar and vector producta, scalar and vector fields
Lecture 3. Cartesian and cylindrical coordinate systems, intro to spherical coordinates
Lecture 4. Spherical coordinates, position vectors (**end chapter 1**). Vector and scalar integration, conservative and nonconservative fields, introduction to gradient

Lecture 5. Gradient, divergence, curl, divergence theorem, Stokes' theorem, null identities
Lecture 6. Helmholz theorem (**end chapter 2**). Coulomb's law (point charges), examples
Lecture 7. Coulomb's law, examples, Electric field intensity of point charges, The electric dipole, line charge densities, examples , examples

Lecture 9. Line charge densities, semi-circular line of charge, examples
Lecture 10. Surface charge distributions, examples
Lecture 11. Volume charge distributions, examples, electric flux density (**end of chapter 3**
Lecture 12. Postulates of the electrostatic field, Gauss's law

Lecture 13. Gauss's law – spherical and cylindrical geometries, examples
Lecture 14. Gauss's law – examples, Gauss's law – planar geometries, lines of charge, superposition
Lecture 15. Gauss's law, planar geometries, superposition, Examples
Lecture 16. Gauss' law, charge distributions, potential of point charges

Lecture 17. Potential due to charge distributions, examples, line, surface and volume charge distributions, examples
Lecture 18. Electric field intensity from potential, conductors, examples, electric field intensity in and around conductors, examples
Lecture 19. Conductors, examples, dielectrics, polarization, Electric flux density, dielectric strength, examples, interface conditions for the electric field, examples

Lecture 21. Interface conditions, examples, capacitance, parallel plate capacitor
Lecture 22. Capacitance, examples, capacitance per unit length, examples
Lecture 23. Capacitance, capacitors in series and in parallel, examples, energy in system of charges
Lecture 24. Energy in system of charges, examples, energy in charge distributions, examples

Lecture 25. Energy in charge distributions, superposition, examples, force from energy, examples (end of chapter 4)
Lecture 26. Boundary value problems, direct integration method, examples
Lecture 27. Method of images – point charges and line charge distributions, volume distributions, examples
Lecture 28. Method of images – multiple planes, general geometries, examples

Lecture 29. Method of images, general configurations, parallel plates, examples
Lecture 30. Method of images in cylindrical and spherical systems, examples
Lecture 31. Method of images, spherical systems and superposition, examples
Lecture 32. Separation of variables, Cartesian coordinates, 2D, examples

Lecture 33. Separation of variables, Cartesian coordinates, 3D, examples, cylindrical coordinates, 2D
Lecture 34. Separation of variables, cylindrical coordinates, examples. (**end of chapter 5**)
Lecture 35. Law of conservation of charge, definition of current and current density, convection current, conduction current and current density, Examples, Ohm's law, calculation of resistance of bodies

Lecture 37. Calculation of resistance, examples, Joule's law, examples, the continuity equation
Lecture 38. Continuity equation, examples, current density as a vector field, interface conditions for current density, examples **(end of chapter 7)**
Lecture 39. The magnetic field, force and magnetic field, right hand rule, the Biot-Savart law
Lecture 40. Biot-Savart law examples

Lecture 41. Biot-Savart law examples
Lecture 42. Biot-Savart law examples, Ampere's law, examples
Lecture 43. Ampere's law examples
Lecture 44. Ampere's law examples

Lecture 45. Magnetic flux density, magnetic flux, postulates of the magnetic field
Lecture 46. Potential functions, magnetic vector potential, examples
Lecture 47. Magnetic vector potential examples, magnetic scalar potential, **(end of chapter 8),** magnetic dipole
Lecture 48. Magnetic dipole moment, magnetic dipole, examples, magnetization

Lecture 49. Magnetization, examples
Lecture 50. Magnetization examples, behavior of magnetic materials, hysteresis curve
Lecture 51. Hysteresis, interface conditions for the magnetic field, examples
Lecture 52. Inductance, self and mutual inductance, examples

Lecture 53. Examples of inductance
Lecture 54. Examples of inductance, energy stored in the magnetic field, Energy in a system of

Lecture 57. Energy based on field variables, examples, magnetic circuits, examples
Lecture 58. Forces in the magnetic field, examples, Neumann formula, examples Virtual displacement method, force from energy, examples, Torque, examples **(end of chapter 9)**
Lecture 59. Faraday's law, emf, Lenz's law, examples
Lecture 60. Transformer action emf, examples, combined motion and transformer action emf, principle of electric motors and generators, examples, the ideal transformer Ideal transformer, real transformer, loosely coupled transformer, examples, **(end of chapter 10)**

Notes:

1. **Summaries of all chapters (except chapters 1 and 2) are available. Please download them as needed.**
2. **If you have any doubts about the course, schedule, assignments, exams, etc., please call or e-mail me immediately.**
3. **Please consult the course outline for additional information**