EE 455 Introduction to Energy Distribution Systems

Spring 2024
Department of Electrical and Computer Engineering
Iowa State University

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Instructor Email	baicui@iastate.edu
Office Hours	M/W 4–5 pm, or by appointment
Teaching Assistant	Hannah Hentzel
TA Email	hgnelson@iastate.edu
Class Time	T/Th 4:10–5:30 pm
Location	Coover Hall 1011

Course Pages Canvas is the primary site where most course material will be posted, such as announcements, lecture slides, homework (including solutions), and grades.

Course Prerequisite EE 303 and EE 324. The course assumes understanding and familiarity of electric power system basics at the level of EE 303, including complex numbers, electric component modeling (mutual inductance, transformer, shunt elements, etc.), three-phase circuit analysis, network analysis, electric power flow analysis, and matrix algebra.

Textbook We will follow the following book:

- William H. Kersting, *Distribution System Modeling and Analysis*, CRC Press, 4th Ed., 2017.

The lecture slides will be made available online and they will cover all the materials needed for homework and exams. In that regard the textbook is not required. However, it is a great book and I highly recommend it if you are interested in the topic and/or intend to work in the field.

The following book contains an accessible chapter on power distribution systems:

- J. D. Glover, T. J. Overbye, M. S. Sarma, and A. B. Birchfield, *Power System Analysis and Design*, Cengage Learning, 7th Ed., 2022.

Class Preparation Reading and studying the scheduled material in the text in advance of the class will be essential. A tentative schedule of topics is given in this syllabus.

Tentative Course Schedule The schedule below is tentative. Adjustments may be made as the course proceeds. (Lecture $w.d$ refers to the Lecture on day d in week w, where $d = 1$ (resp., 2) refers to Tuesday (resp., Thursday). For example, Lecture 1.1 refers to Tuesday's Lecture in week 1.)

Voltage Regulation
Lecture 12.1 ..... WK Chapter 7
Voltage Regulation
Lecture 12.2 ..... WK Chapter 8
Three-phase Transformers
Lecture 13.1 ..... WK Chapter 8
Three-phase Transformers
Lecture 13.2 ..... WK Chapter 8
Three-phase Transformers
Lecture 14.1 ..... WK Chapter 8
Three-phase Transformers
Lecture 14.2 ..... WK Chapter 10
Distribution System Power Flow Analysis
Lecture 15.1 ..... WK Chapter 10
Distribution System Power Flow Analysis
Lecture 15.2 ..... WK Chapter 10
Distribution System Power Flow Analysis
Lecture 16.1 ..... Prep Week
Review and Examples
Lecture 16.2 ..... Prep Week
Review and Examples
Week 17 ..... No Class
Final Exam

Exams There will be an 80-minute in-class midterm exam during the semester and a comprehensive final exam. Both the midterm and final exams are closed book and closed notes. Two formula sheets (both sides of 8.5" x 11" paper) are allowed for the midterm exam, and three formula sheets for the final exam. The formula sheet(s) should be handwritten, not scanned or printed. The final exam is comprehensive. It will cover all the material throughout the semester.

No make-up exams will be given, unless there is a legitimate reason for missing the exam that is not under the student's control, and the student makes appropriate arrangement with the instructor in advance of the scheduled exam. **No make-up exam will be given if the instructor is not notified prior to the exam.** Exam dates may be different from the syllabus. It is your responsibility to know the exam dates.

Questions concerning a grade given for any assignment or exam must be presented to the instructor within a week after the grade is received. **No exceptions to this rule will be permitted at any time, for any reason.**

Homework I will assign some homework problems to help you consider more deeply some of the material we covered in class. Solutions to the problems will be made available to you on Canvas.

You can either submit them on Canvas or send them to the TA via email. Homework will be graded by the TA. You are expected to see about 5–7 homework assignments.

It is important to keep up with the pace of this course. It is therefore important to turn in the homework on time so that the TA can have them graded and returned to you in a timely

manner. **Late homework will incur 15 points deduction (on a 100-point scale) every 24 hours.** The minimum grade you can get is zero.

Grading Policy Three components determine your grade: Homework, Midterm, and Final. The relative weights are as follows:

Midterm Exam	16%
Final Exam	24%
Homework	60%

You are guaranteed to receive at least the letter grades determined by the guidelines below:

90 and above	A
80 – 89	A-/B+/B
70 – 79	B-/C+/C
60 – 69	C-/D+/D
60 and below	D-/F

Course Objectives At completion of this course, students should be able to

- Understand the distinct features of power distribution systems. Understand and able to identify major components of major components and pieces of equipment (including substations, transformers, overhead lines, cables, etc.).
- Be able to model overhead lines and underground cables.
- Be able to carry out approximate calculations for voltage drop, line impedance, distributed loads, lumped loads.
- Analyze various three-phase distribution transformer connections and the effect of unbalance on the transformer winding ratings.
- Develop code to perform a three-phase power flow for a radial distribution system. Form impedance matrices of distribution lines, given the line configuration and physical characteristics.

Attendance Attendance is strongly encouraged, but role will not be called. However, you are responsible for all information presented in class. The website and instructor, although available to you, are not responsible for providing you with in-class information if you choose not to attend class.

Communication Feel free to communicate with the instructor in any way that is convenient to you (after class, during office hours, phone, e-mail), for questions about the course material or homework. E-mail is an especially good way, but response time here is variable, typically ranging from a minute to about 24 hours, depending on the nature of your question and the instructor's schedule.

Academic Honesty Suspected cases of academic misconduct, as defined in the Honor Code, will be turned over to the V.P. for Student Services.

Special Accommodations Please address any special needs or special accommodations with your instructor the first day of class or as soon as you become aware of your needs. Those seeking accommodations based on disabilities should obtain a Student Academic Accommodation Request (SAAR) from the Disability Resources Office.

Student Disability Resources

- Address: 1076 Student Services Building, Ames, IA 50011-2222
- Phone: 515 294-7220
- Fax: Fax: 515 294-2397
- TTY: 515 294-6635
- E-mail: disabilityresources@iastate.edu
- Website: http://www.dso.iastate.edu/dr/