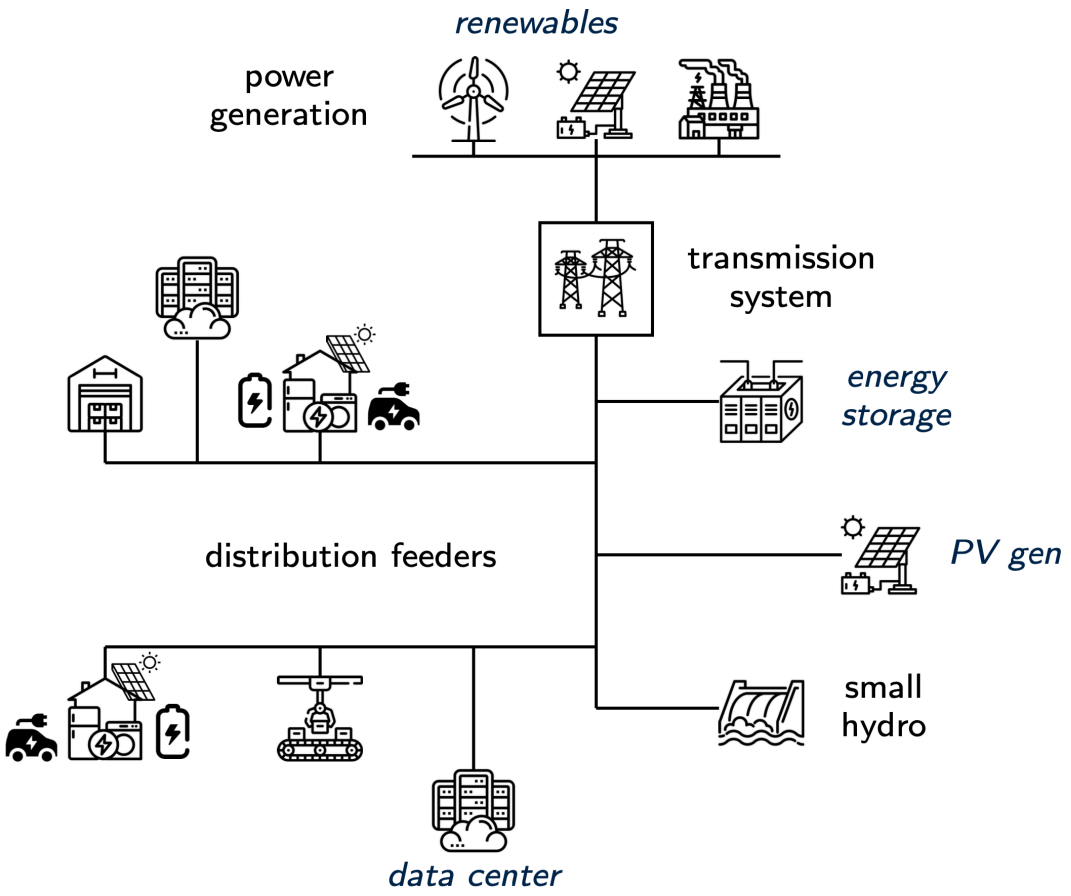
EECS 463: Power System Design and Operation - Fall 2024



Summary: Modern society is highly dependent upon reliable, economic electricity supply. This course will provide students with the knowledge and skills required to analyze and design power systems. It will develop models and tools for investigating system behavior, and provide opportunities for using those tools in design processes. Optimal generation dispatch will be developed, and electricity market implementation issues addressed. The impact of renewable generation on power system operation will be considered.

Course Instructor: Prof. Vladimir Dvorkin (https://web.eecs.umich.edu/~dvorkin/) email: dvorkin@umich.edu (mailto:dvorkin@umich.edu)

Course Time: Tue/Thu 8:30AM-10:00AM

Classroom Location: DOW 1206

- Lectures will be in-person in the classroom
- Lectures will be recorded and posted on Canvas after class
- All lecture material (notes, handouts, etc.) will be posted after class
- In-person attendance is highly encouraged
- If in-person lecture isn't possible for any reason, the lecture will be held over Zoom through Canvas

Instructor Office Hour: Thursday 12:00 PM – 2:00 PM, **Location:** 4240 (Prof. Vladimir Dvorkin) EECS Building

- If you would like to attend office hours via Zoom, please let me know
- Office hours are not held on holidays or breaks
- Office hours are not recorded
- Normally during office hours all students will talk together with the instructor. If you require a 1-1 discussion, please let Prof. Dvorkin know. If it is possible to discuss 1-1 during that office hour, we will do that. If it is not possible, email me to find another time for a 1-1 discussion.

Piazza: All technical questions/concerns should only be communicated over Piazza. Feel free to post questions on course material, homework, etc. You are encouraged to answer each other's questions. The instructor will up-vote answers and also respond to questions. Piazza is not monitored by the instructor over weekends, holidays, and university breaks. Otherwise, the instructor will generally check Piazza at least once per day.

Enroll to Piazza at **https://piazza.com/umich/fall2024/eecs463 (https://piazza.com/umich/fall2024/eecs463)**

Notice: The Instructor will **not** respond to any emails involving course-related technical questions. All technical questions/concerns should only be communicated in the class, during the office hours or on Piazza. However, emails regarding personal issues (e.g., dealing with stress, and health issues) will be looked into and answered.

Prerequisite: Physics 240 (General Physics II) or 260 (Honors Physics II), EECS 215 (Circuits), EECS 216 (Signals & Systems) or Graduate Standing; Other useful skills include differential equations, matrix algebra, and computer programming.

Textbooks: Our primary textbook is *J.D. Glover, T.J. Overbye, and M.S. Sharma, Power System Analysis and Design, 6th edition, Cengage Learning, 2017.*

Another good resource is *A.R. Bergen and V. Vittal, Power System Analysis, 2nd edition, Prentice*

Hall, 2000.

Software: PowerWorld Simulator (https://www.powerworld.com/gloveroverbyesarma) (https://www.powerworld.com/gloveroverbyesarma) , MATLAB, or your coding language of choice.

Assessment: The final grade breakdown:

Assessment	Percentage
Homework	20 %
Projects	25%
Midterm Exams	25%
Final Exam	25%
Quiz	4%
Course evaluation	1%

The breakpoint between an A- and B+ will be 90.0% OR LOWER, meaning that if you obtain > 90.0% you will receive some sort of A (A-, A, or A+) in the course. The breakpoint between B- and C+ will be 80.0% OR LOWER. The breakpoint between C- and D+ will be 70.0% OR LOWER. Breakpoints may be lowered depending on the performance of the class; breakpoints will not be raised.

Homework: There will be approximately eight homework assignments. In addition to completing quantitative problems, you may also be asked to read articles/reports and write analyses. You are encouraged to discuss problems, solution approaches, and readings with your peers. However, your submitted solutions, code, write-ups, etc. must be your own work.

Exams: There will be two in-class midterm exams. The exact date/details will be announced later in the semester. There will be a final exam. The final exam day/time will be set by the University. All exams are to be done entirely individually.

Project: There will be two projects. The first will be a deep-dive into a current topic in power systems. The second will be a power systems design project with using PowerWorld Simulator.

Re-grades: If you believe there is an error in the grading of your assignment or exam you may re-submit it for a re-grade within one week of receiving your grade. You must provide a detailed written explanation of the issue. Your grade may increase or decrease.

Late work: In fairness to all students, late work is not normally accepted. If there is an extenuating circumstance, please contact Prof. Mathieu well before the due date. To provide some flexibility, your lowest homework grade will be dropped.

Academic Integrity: The College of Engineering is a community in which personal responsibility, honesty, fairness, respect, and mutual trust are maintained. You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation will result in a minimum academic penalty of your failing the assignment, and will result in additional disciplinary measures. This includes, but not limited to, cheating, using unauthorized material during exams, using or copying another student's work, and any other form of academic misrepresentation. For a list of actions that constitute misconduct, and possible sanctions for those actions, please see the Code of Conduct **https://bulletin.engin.umich.edu/rules/ (https://bulletin.engin.umich.edu/rules/)**

Please read the UM Library's website on plagiarism: **http://guides.lib.umich.edu/c.php?g=283392&p=1887232 (http://guides.lib.umich.edu/c.php?g=283392&p=1887232)**

Any plagiarism will be referred to the CoE Honor Council: **https://ecas.engin.umich.edu/honor-council/ (https://ecas.engin.umich.edu/honor-council/)**

Statement on Generative AI: Learning how to use software that emulates human capabilities (e.g., ChatGPT) is important for all of us. Used properly, ChatGPT can enhance our work; used improperly, it can border on plagiarism. Moreover, it may make it difficult for the grading staff (and, possibly, you yourself) to gauge your understanding of the material. In principle, you may submit material that contains AI-generated content, or is based on or derived from it, as long as this use is properly disclosed and documented. You must include an explanation as to (1) what was your original prompt to the software; (2) what was the output; and (3) how you reworked/revised the output to correct any errors, put text into your own voice/style, etc. Your documentation should make the process transparent – the submission itself should meet CoE standards of attribution and validation. Violations of the explicit disclosure and documentation requirement may subject students to standard CoE Honor Council processes.

Commitment to Equal Opportunity: The Faculty of the CoE are committed to a policy of equal opportunity for all persons and do not discriminate on the basis of race, color, national origin, age, marital status, sex, sexual orientation, gender identity, gender expression, disability, religion, height, weight, or veteran status. In this class, I aim to treat everyone with fairness and respect, and I expect you to do the same. Please feel free to contact me with any problem, concern, or

suggestion.

Accommodations for Students with Disabilities: U-M is committed to providing equal opportunity for participation in all programs, services, and activities. Request for accommodations by persons with disabilities may be made by contacting the Services for Students with Disabilities (SSD) Office, G-664 Haven Hall, 763-3000, http://ssd.umich.edu. After your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation (VISA) form. I will arrange for the accommodations indicated by this form. Any information you provide is private and confidential and will be treated as such. Please provide me with this information as soon as possible and at least a week prior to any need for accommodation.

Student Mental Health and Wellbeing: U-M is committed to advancing student mental health and wellbeing. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact Counseling and Psychological Services (CAPS) at (734) 764-8312 and https://caps.umich.edu/ during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service at (734) 764-8320 and https://www.uhs.umich.edu/mentalhealthsvcs. You are also encouraged to discuss your concerns with your academic advisor and to contact the CoE C.A.R.E. Center https://care.engin.umich.edu/. Please feel free to also discuss related issues with me.

Course Syllabus

Date	Unit	Topic	Homework, Project & Finals
08.27	Electric Power System Background	Overview of system structure: generation, transmission, and distribution	
08.29		Utility restructuring and deregulation	
09.03			HW1 Release (due on 09.10)
09.05	Fundamental Analysis Techniques	Review of phasors in sinusoidal steady state circuit analysis	
09.10		RMS quantities	HW2 Release (due on 09.17)
09.12		Concepts of active and reactive power (class on Zoom)	
09.17		Three phase operation (part I)	HW3 Release (due on 09.24)
09.19		Three phase operation (part II)	
09.24		Three phase connections and per phase analysis	Midterm 1
09.26	Transformer Modeling	Intro to transformers	HW4 Release (due on 10.3)
10.01		Ideal transformer	
10.03		Per unit normalization (part I)	HW5 Release (due on 10.17)
10.08		Per unit normalization (part II)	
10.10		Use of tap changing and phase shifting transformers for control	
10.15	**Fall Study Break**		
10.17	Power Flow Analysis	Introduction to power flow modeling	HW6 Release (due on 10.31)
10.22		Power flow formulation and solution techniques (part I) (class on Zoom)	Project release (due on 11.07)
10.24		Power flow formulation and solution techniques (part II)	
10.29		Variable decoupling	
10.31		Applications	
11.05	Transmission Line Parameters and Modeling	Line geometry and physical parameters (part I)	HW7 Release (due on 11.12)
11.07		Line geometry and physical parameters (part II)	
11.12		Lumped circuit equivalent models	
11.14	Economic Operation and Electricity Markets	Economic dispatch	HW8 Release (due on 11.21)
11.19		Optimal power flow	
11.21	Power Systems Operation and Control	Turbine governor control	Midterm 2
11.26		Load frequency control	
11.28	**Thanksgiving**		
12.03	Fault and protection	Symmetrical components in fault calculations	
12.05		Protection devices	