COLORADO SCHOOL OF MINES
ELECTRICAL ENGINEERING DEPARTMENT

EENG577 – Advanced Electrical Machine Dynamics for Smart-Grid Systems

Spring 2025
Online Course

Instructor: **Dr. Abd A. Arkadan**
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Virtual Office Hours: T/Th 11:30am - 12:30pm
- To be held on Zoom at the scheduled times.
- Simply click the link to log on: Sp25 Office Hours

Course Description: This online course provides engineering science analysis and focuses on the application of the abc frame of reference to develop state space and equivalent network models for electric machines and drive systems.
The course focuses primarily on the modeling and dynamic performance prediction of electric machines and associated power electronic in smart grids and renewable energy systems/subsystems. The developed models will be used in computer simulations for the characterization and performance prediction of synchronous and induction machines, permanent magnet synchronous machines synchronous reluctance and switched reluctance machines.

Credits: 3 Semester Credit Hours

Prerequisite: EENG389 Fundamentals of Electric Machinery

Recommended Textbooks:
- *Electric Machinery,* by Fitzgerald, Kinsley, and Umans, Recent Edition, McGraw Hill
- *Electric Machinery Fundamentals,* by Stephen J. Chapman, Recent Edition, McGraw Hill

Student Learning Outcomes:

After the successful completion of the course, the students should be able to:

1. Explain power calculations, magnetic fields/circuits/material, and power/torque relationships of energy conversion devices.
2. Explain principles of operation of selected energy conversion devices used in smart grid applications.
3. Write and explain a device state space model and illustrate, label, and describe a device equivalent circuit model and relate its parameters and terminal inputs/outputs to those of an actual device.

4. Use state space models/equivalent circuits to predict and analyze device external operational characteristics (current, voltage, power, energy, torque, speed, losses, efficiency, etc.)
5. Compute the energy conversion device model parameters (reactance and resistance) and/or initial conditions (current, voltage, power, torque, speed, losses) and implement utilizing a computer tool (MATLAB/SIMULINK)
6. Develop and design a system/sub-system with an energy conversion device. Implement the state space model/equivalent circuit with MATLAB and/or SIMULINK to predict, analyze, and critique the external performance characteristics (current, voltage, power, energy, torque, speed, losses, efficiency, etc.).
7. Prepare and write in groups of 2/3 students an IEEE formatted paper to explain, analyze, and critique a case study from one of the modules of weeks 3-7. Present in poster format at the course Final Project: Online Mini-Conference.

Grading:

- On a 100% base:
  - Assignments/ 30%
  - Projects/ 50%
  - Final Project/ 20%

- The following grading scale ranges will be used for this course:

A	B	C	D	F
90 – 100	80 – 89	70 – 79	60 – 69	Below

Rules for Assignments:

- Assignments are **due on CANVAS at 11:59PM MST on the designated day** and must be submitted as a **PDF file** format and should be **clear, organized, and you must show all your work.**
- All assignments will be submitted digitally through Canvas. If you are submitting written work, you can use free apps like *camscanner* to convert your written work to a pdf using your phone's camera.
- In general, barring extenuating circumstances, late assignments are not accepted. However, the Course Instructor may accept a late submission of no more than 24 hours, with a penalty of 10%. No individual assignments are accepted after 24 hours from the due submission time.

Class Preparation: Proper reading of handouts/textbook/research papers and working example problems are important part of learning the fundamentals of this course.
Computer Tools: MATLAB/Simulink, which should be familiar from previous classwork, will be used to perform the calculations in all projects and possibly homework assignments.

Communications: Please use the "Discussions" option on Canvas as much as possible. I will send out class-wide messages via Canvas Announcements. Please check these two boards first before making a new post. Also, used the "Chat" option during lectures to ask questions. For truly private communications, please feel free to email me with a question that pertains to you individually, but I will direct all other communication to Canvas. This both saves me from having to potentially respond to duplicate emails and helps your classmates (as they might have the same question).

Profile in Canvas:
As part of the learning experience at the Colorado School of Mines, our class will be utilizing online

learning resources and experiences through the Canvas learning management system. In order to help build community in this remote learning environment, **you need to upload your headshot as a profile picture and full name to Canvas**. *Photos should be like the photos taken for passports or state identification cards.*

Expectations of online etiquette or netiquette:
Here are few do's and don'ts about communicating in your course through emails or in online discussion forums:

- **Do**…
  - Ask questions and engage in conversations as often as possible—feel free to contact the instructor via the discussion forum for questions or via email or other communication.
  - Be patient and respectful of others and their ideas and opinions they post online.
  - Remember to be thoughtful and use professional language. Keep in mind that things often come across differently in written text, so review your writing before posting.
  - Be prepared for some delays in response time, as "virtual" communication tends to be slower than "face-to-face" communication.
  - Contact the instructor if you feel that inappropriate content or behavior has occurred as part of the course.
  - Check the syllabus and course policies stated by your instructor to know what to expect about your instructor's turnaround time for responding.

- **Do NOT**…
  - Use inappropriate language—this includes, but is not limited to, the use of curse words, swearing, or language that is derogatory.
  - Post inappropriate materials—for example, accidentally posting/showing a picture that is not appropriate for the course content.
  - Post in ALL CAPS, as this is perceived as shouting and avoid abbreviations and informal language ("I'll C U L8R").
  - Send heated messages even if you are provoked. Likewise, if you should happen to receive a heated message, do not respond to it.
  - Send an email or post to the entire class, unless you feel that everyone must read it.

Diversity and Inclusion:
At Colorado School of Mines, we understand that a diverse and inclusive learning environment inspires creativity and innovation, which are essential to the engineering process. We also know that in order to address current and emerging national and global challenges, it is important to learn with and from people who have different backgrounds, thoughts, and experiences.

Our students represent every state in the nation and more than 90 countries around the world, and we continue to make progress in the areas of diversity and inclusion by providing Diversity and Inclusion programs and services to support these efforts.

Disability Support Services:
The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me. Students with disabilities may also wish to contact Disability Support Services (DSS) to discuss options to removing barriers in this course, including how to register and request official accommodations. Please visit their website at disabilities.mines.edu for contact and additional information. If you have already been approved for accommodations through DSS, please meet with me at your earliest convenience so we can discuss your needs in this course.

Accessibility within Canvas:
Read the Accessibility Statement from Canvas to see how the learning management system at the Colorado School of Mines is committed to providing a system that is usable by everyone. The Canvas platform was built using the most modern HTML and CSS technologies and is committed to W3C's Web Accessibility Initiative and Section 508 guidelines.

Discrimination, Harassment, and Title IX:
All learning opportunities at Mines, including this course, require a safe environment for everyone to be productive and able to share and learn without fear of discrimination or harassment. Mines' core values of respect, diversity, compassion, and collaboration will be honored in this course, and the standards in this class are the same as those expected in any professional work environment. (More information can be found here.) Discrimination or harassment of any type will not be tolerated. As a participant in this course, we expect you to respect your instructor and your classmates. As your instructor, it is my responsibility to foster a learning environment that supports diversity of thoughts, perspectives and experiences, and honors your identities. To help accomplish this:

- Course rosters are provided to the instructor with the student's legal name. I will honor your request to address you by a preferred name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.
- If something is said or done in this course (by anyone, including myself) that made you or others feel uncomfortable, or if your performance in the course is being impacted by your experiences outside of the course, please report it to:
    - Me (if you are comfortable doing so)
    - Wellness Center - Counseling (https://www.mines.edu/counseling-center/)
    - Speak Up (https://www.mines.edu/speak-up/) - Anonymous Option

In this course, we will cultivate a community that supports survivors, prevents interpersonal violence, and promotes a harassment free environment. Title IX and Colorado State law protects individuals from discrimination based on sex and gender in educational programs and activities. Mines takes this obligation seriously and is committed to providing a campus community free from gender and sex-based discrimination. Discrimination, including sexual harassment, sexual violence, dating violence, domestic violence, and stalking, is prohibited and will not be tolerated within the Mines campus community. If these issues have affected you or someone you know, you can access the appropriate resources here: http://www.mines.edu/title-ix/. You can also contact the Mines Title IX Coordinator, Camille Torres, at 303.384.2124 or titleix@mines.edu for more information.
It's on us, all of the Mines community, to engineer a culture of respect.

CARE @ Mines:
If you feel overwhelmed, anxious, depressed, distressed, mentally or physically unhealthy, or concerned about your wellbeing overall, there are resources both on- and off-campus available to you. If you need assistance, please ask for help form a trusted faculty or staff member, fellow student, or any of the resources below. As a community of care, we can help one another get through difficult times. If you need help, reach out. If you are concerned for another student, offer assistance and/or ask for help on their behalf. Students seeking resources for themselves or others should visit care.mines.edu.
Additional suggestions for referrals for support, depending on comfort level and needs include:

- CARE at Mines: care.mines.edu for various resources and options, or to submit an online "CARE report" about someone you're concerned about, or email care@mines.edu
- CASA - https://www.mines.edu/casa/ for academic advising, tutoring, academic support, and academic workshops
- Counseling Center – https://www.mines.edu/counseling-center/ or students may call 303-273-3377 to make an appointment. There are also online resources for students on the website. Located in the Wellness Center 2nd floor. Located at 1770 Elm St. (photo below)
- Health Center - https://www.mines.edu/student-health/ or students may call 303-273-3381 for appointment. Located in Wellness Center 1st floor.
- Colorado Crisis Services - For crisis support 24 hrs/7 days, either by phone, text, or in person, Colorado Crisis Services is a great confidential resource, available to anyone. http://coloradocrisisservices.org , 1-844-493-8255, or text "TALK" to 38255. Walk-in location addresses are posted on the website.
- Food and/or Housing - Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. Furthermore, please notify your professor if you are comfortable in doing so. This will enable your professor to provide resources that may be available.

All of these options are available for free for students. The Counseling Center, Health Center, and Colorado Crisis Services are confidential resources. The Counseling Center will also make referrals to off-campus counselors, if preferred.

In an emergency, you should call 911, and they will dispatch a Mines or Golden PD officer to assist.

Absence Policy:

The Student Absences webpage outlines CSM's policy regarding student absences. It contains information and documents to obtain excused absences.

Note: All absences that are not documented as excused absences are considered unexcused absences. Faculty members may deny a student the opportunity to make up some or all of the work missed due to unexcused absence(s). However, the faculty members do have the discretion to grant a student permission to make up any missed academic work for an unexcused absence. The faculty member may consider the student's class performance, as well as their attendance, in the decision.

In the case of an absence, the student is responsible for determining what work was missed and for putting forth a good faith effort to review the material on their own.

Policy on Academic Integrity/Misconduct: (complete policy is found in the Mines' Policy Library)

The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining an fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

Coursework Return Policy:
In general, most work should be returned within two weeks, along with suitable materials/feedback that enable students to understand how to improve their learning/performance.

Expectations for Participation
You are expected to engage in all course activities, tasks, and assignment as an emerging professional. You are expected to spend between 17-22 hours on this course each week.

EENG577 Spring 2025 Online Course Calendar

Week #	Date	Topic
1.	**Jan. 06**	**Week-1 M1: Review**
		Assignments due week of Jan 06: M1-Quiz, M1-A1, M1-A2
2.	**Jan. 13**	**Week-2 M2: Transformers and State Space**
		Assignments due week of Jan 13: M2-Quiz, M2-A1, M2-A2, M2-Proj
3.	**Jan. 20**	**Week-3 M3: Synchronous Machines State Space Modeling**
		Assignments due week of Jan 22 M3-A1, M3-Proj
4.	**Jan. 27**	**Week-4 M4: Synchronous Machines dq0 Transformation**
		Assignments due week of Jan 27: M4-Proj
5.	**Feb. 03**	**Week-5 M7: Reluctance Machines**
		Assignments due week of Feb 03: M7-Proj
6.	**Feb. 10**	**Week-6 M5: Advanced Topics - PM Synchronous Machines**
		Assignments due week of Feb 10: M5-A1, M5-Proj
	Feb. 16	***Final Project Proposal Due***
7.	**Feb. 17**	**Week-7 M6: Induction Machines**
		Assignments due week of Feb 17: M6-Proj
8.	**Feb. 24**	**Week-8 M8: Final Project**
	Mar. 02	***Final Project Paper Due***
	Mar. 04	***Final Project Presentations*** *Tuesday 12:00 - 2:00 pm MT*