ECE 461: Power Systems

Syllabus
Fall Semester, 2024

Professor:	Dr. James Cale	Email:	James.Cale@colostate.edu
TA:	Brian Chan	Email:	Brian.Chan@rams.colostate.edu

Course Description: Introduction to the analysis of electrical power systems in terms of current, voltage, and active/reactive power. Introduction to the analysis of electrical motors and drives. Computer-aided simulation for the analysis of power systems, power electronic drives and motor operations. This course also includes laboratories to reinforce course content and enhance students' understanding of power systems. 4 credit hours.

Lecture Location and Time

Rockwell Hall, room 39, CSU Fort Collins campus, Tuesday and Thursday, 12:30–1:45 PM (MST).

Laboratory Location and Time

Engineering Building, room C207, CSU Fort Collins campus. Time periods for the laboratories will be established in the first few weeks of class.

Prerequisites[†]

- ECE 332 (with a grade of C or higher)
- Working knowledge of MATLAB is required for this class.

Course Materials

All course material for this class (lecture and laboratory) will provided by the instructor, which will include written lecture notes and slides. No textbook is required.

Communication Policy

Questions on the course material can usually be answered most quickly via Canvas messaging or email; this is the preferred method when possible. The TA and/or instructor will respond to your inquiry within 36 hours (typically sooner). For more in-depth questions, use office hours.

Office Hours

The instructor will hold regular office hours on T/Th, 11:00–12:00 (MST). By default, office hours will be held via Zoom. If you would like to meet in-person, please arrange with the instructor at least one day in advance. Office hours may also be requested with the TA; contact the TA to schedule online on in-person office hours.

[†]Contact the instructor (jcale@colostate.edu) with questions and/or requests for waivers for the prerequisites.

Homework

Homework will consist of shorter analytical and/or simulation problems. Homework will generally be due in approximately 1.5 weeks, e.g., released on a Tuesday and due on Thursday of the following week. No late homework will be accepted; however, **one homework score will be dropped.**

Exams

There will be three in-class examinations in this class; the final exam will be comprehensive. Exam problems will be based on the material discussed in lecture, homework, and laboratories. No make-up exams will be given, except possibly under severe extenuating circumstances. If unable to make a deadline or comply with a time constraint for any reason, contact the instructor at least five days beforehand.

Exam Dates

Exam 1	Sept. 24th
Exam 2	Oct. 29th
Final exam:	Dec. 10th

Laboratories Assignments

There will be a total of five (5) laboratories for this class, with four (4) assignments ("lab reports") that are due, see additional detail in the ECE 461: Power Systems Laboratory document.

Course Grading Weights

Homework	25%
Lab Reports	25%
Exam 1	15%
Exam 2	15%
Final Exam	20%

Computer Simulations

Course homework may include simulations using MATLAB/Simulink (Simscape Electrical library). The purpose of these simulations is to give you more experience applying the analysis techniques introduced in class and laboratories.

Software

MATLAB installation `https://www.engr.colostate.edu/ets/matlab/`

Regrades

Regrading can only be accommodated under two circumstances: (1) incorrect calculation of scores or (2) incorrect assignment of scores. **All requests for regrading must be turned in within 5 days of the return of the graded homework/exam**. If requesting a regrade, email the TA with an explanation of your regrade request. Note that your solution to the entire problem as well as the regrade request will be scrutinized; final allocation of credit is at the discretion of the TA.

Lecture Topics by Week:[†]

Week	Dates	Topic
1	8/20, 8/22	Course introduction, notation, review of phasor analysis
2	8/27, 8/28	Energy and power, power balance, complex power flow analysis
3	9/3, 9/5	Power factor, power factor correction
4	9/10, 9/12	Magnetic equivalent circuits, quantifying inductance
5	9/17, 9/19	Single-phase transformers, transformer analysis
6	**9/24***, 9/26	Exam 1 (9/24), intro to DC motors
7	10/1, 10/3	DC motor theory and operation, DC/DC converter drives
8	10/8, 10/10	DC/DC converter drives (cont.), feedback control of DC motors
9	10/15, 10/17	Feedback control design for DC motors
10	10/22, 10/24	Three-phase power flow, $\Delta-$Y connections
11	**10/29***, ~~10/31~~	Exam 2 (10/29), no class on 10/31
12	11/5, 11/7	Synchronous generators, transmission lines
13	11/12, **11/14**	Per-unit system, nodal admittance matrices, class tour Tristate
14	11/19, 11/21	Newton-Raphson algorithm, Jacobians and constraints
15	~~11/26~~, ~~11/28~~	Fall recess (no class sessions this week)
16	12/5, 12/7	Three-phase power flow solution
17	**12/10***, ~~12/12~~	Final exam (12/10), no class on 12/12

*Exam date.

Lecture Material and Text

Knowledge in this course is cumulative, so it's important to attend the lectures and complete all homework assignments. If you do not attend a lecture, or need to review prerequisite technical concepts or coding in MATLAB/Simulink, you are responsible for reviewing the material on your own time.

Working Together

Studying together in this class is encouraged, and laboratories are group assignments. However, any individual assignments (homework and exams) *must be solely your own work*. Homework solutions will be checked to ensure academic honestly. Academic misconduct has serious consequences (see below).

[†]Session topics and dates may change based on added/deleted material and observed progress of students. In the event that the instructor is on business-related travel or personal (sick or emergency) leave the respective class may be canceled or taught by the teaching assistant.

Final Grade Assignments

Grade	Score
A+	96.67–100.00
A	93.33–96.66
A−	90.00–93.32
B+	86.67–89.99
B	83.33–86.66
B−	80.00–83.32
C+	76.67–79.99
C	70.00–76.66
D	60.00–69.99
F	0.00–59.99

Academic Integrity

The faculty expects every member of the CSU community to practice honorable and ethical behavior both inside and outside the classroom. Any actions that might unfairly improve a student's score on homework or examinations will be considered academic misconduct and will not be tolerated. Examples of academic misconduct include (but are not limited to):

- Sharing results or other information during homework or examination.
- Representing as your own work anything that is the result of the work of someone or something (AI) else. This includes solutions obtained via solution manuals, the Internet and/or other services.
- Bringing forbidden material or devices to an examination.
- Working on an exam before or after the official time allowed.
- Requesting a regrade of answers or work that has been altered.

At the professor's discretion, academic misconduct on an assignment or examination/report will result in a reduced score, a zero score, or a failing grade for the course. All occurrences of academic misconduct will be reported to the Vice President for Student Affairs and copied to the ECE Department Head. If there is any question as to whether a given action might be construed as academic misconduct, please see the professor before you engage in any such action. For more information, please see CSU's page on Practicing Academic Integrity.* For information on the Honor Pledge, see the Honor Pledge.†

*http://learning.colostate.edu/integrity/

†http://tilt.colostate.edu/integrity/honorpledge/

Sexual Harassment-Free Environment

Colorado State University strives to create and maintain a work and study environment that is fair, humane, and responsible so that each member of the University community is treated with dignity and rewarded for such relevant considerations as ability and performance. Abusive treatment of individuals on a personal or stereotyped basis is contrary to the concepts of academic freedom and equal opportunity. Sexual harassment is one form of such abuse and cannot be tolerated.

For more information, please see the CSU Office of Equal Opportunity's Sexual Harassment Policy[‡] and Principles of Community[§].

COVID-19 University Policy

We will follow any COVID-19 policies directed by the university. For the latest information about the University's COVID resources and information, please visit the CSU COVID-19 site: https://covid.colostate.edu/.

Additional Resources and Policies

For additional information on university resources and policies, see the "Resources and Policies" document posted under Canvas > Modules > Organizational.

[‡]http://oeo.colostate.edu/sexual-harassment-policy

[§]http://oeo.colostate.edu/colorado-state-university-principles-of-community/

ECE 461: Power Systems Laboratory

Fall Semester, 2024

TA: Brian Chan Email: Brian.Chan@rams.colostate.edu

Description: These laboratories are designed to reinforce course content and enhance students' understanding of power systems.

Laboratory Location

Engineering Building classroom C207, CSU Fort Collins campus.

Laboratory Information & Workbench Download

`https://sciamble.com/Resources/pe-drives-lab/basic-drives`

Laboratories & Assignments

There will be a total of five (5) laboratories for this class, with four (4) assignments ("lab reports") that are due, see the schedule of lab weeks and due dates below. The laboratory descriptions and assignments are provided under "List of experiments" on the `sciamble` page linked above, experiments $1-5$. Lab reports need to be uploaded to Canvas by the group leader before the due date for full credit.

Laboratory Groups

The Teaching Assistant (TA) will divide the class into lab groups of approximately four (4) students each at the beginning of the semester. The groups will be posted in Canvas under People > Groups. If a group of students would like to form their own group, let the TA know as soon as possible; any changes must be made by **Aug. 27th** so laboratory meeting dates/times can be coordinated before the first laboratory. Your group will work together on laboratory experiments and lab reports.

Each group needs to designate a leader; the group leader will be responsible for ensuring the lab reports are submitted in time on behalf of the group.

Laboratory Dates & Times

The TA will post open time slots in Canvas the first week of class. Let the TA know via email or Canvas which times your group would like to perform the experiments. Finalized laboratory dates/times for each group will then be posted on Canvas.

Communication Policy

Questions on the laboratories and/or lab reports should directed to the TA via Canvas messaging or email. A response to your inquiry will be provided within 36 hours (but typically sooner).

Assignment Points

Assignment 1 (Report for Labs 1 & 2):	25 pts
Assignment 2 (Report for Lab 3)	25 pts
Assignment 3 (Report for Lab 4):	25 pts
Assignment 4 (Report for Lab 5):	25 pts

Laboratory Descriptions and Execution Week

Lab	Week	Description
1	3	Introduction: An introduction to the basic components of an electric drive system and general idea of the speed-control of a DC motor.
2	5	Switched-mode DC-DC converter: Modeling of a SMDC-DC electronic converter in Workbench simulation software.
3	8	Characterization of DC motor: Determining the parameters of a DC motor and modeling it in Workbench simulation software.
4	11	DC motor speed control
5	15	Four-quadrant operation of DC motor

Tentative Assignment Due Dates

Assignment 1 (Report for Labs 1 & 2):	Oct. 1st
Assignment 2 (Report for Lab 3)	Oct. 15th
Assignment 3 (Report for Lab 4):	Nov. 12th
Assignment 4 (Report for Lab 5):	Dec. 3rd

Academic Integrity

Students are expected to work together on laboratory assignments. However, all work performed and submitted by your group must be solely the group's work. Any material (e.g., text, images) used in a report that is not contained in the assignment description or produced by your group must be appropriately cited. See ECE 461 syllabus for further details regarding academic integrity.

Sexual Harassment-Free Environment

Colorado State University strives to create and maintain a work and study environment that is fair, humane, and responsible so that each member of the University community is treated with dignity and rewarded for such relevant considerations as ability and performance. Abusive treatment of individuals on a personal or stereotyped basis is contrary to the concepts of academic freedom and equal opportunity. Sexual harassment is one form of such abuse and cannot be tolerated.

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