

**Clemson University**  
**Holcombe Department of Electrical and Computer Engineering**  
**ECE 8240, Spring 2023**  
**POWER SYSTEM PROTECTION**  
**Syllabus**

**Instructor:** Dr. Sukumar Brahma  
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**Office Hours:** Tuesday, Thursday 3:30 PM to 5:00 PM, or by appointment.

**Class Location :** Riggs 223, ZGEC 104 – 2:00 PM to 3:15 PM; Tuesday, Thursday.

**Course Website :** Canvas

**Text:**

(a) Power System Relaying, Principles and Applications, 4<sup>th</sup> Ed.; Blackburn, and Domin; CRC Press, New York. ISBN-13: 978-1439888117, ISBN-10: 1439888116

Other books:

(b) Network Protection and Automation Guide, Alstom Grid, May 2011, downloadable from internet. Provided under folder Files/Books and Papers on Canvas.

**Course Description:** Fundamental relay operating principles and characteristics. Current, voltage, directional, differential relays; distance relays; pilot relaying schemes. Standard protective schemes for system protection. Operating principles and overview of numerical relays. **Required preparation is ECE 4180/6180 or equivalent.**

**Homework:**

Homework will be assigned almost every week. You will get one week to finish it. It will be assigned through Canvas. *No late homework will be accepted* and each late homework will result in zero grade.

Solving the homework questions with understanding will be a key to success; you are urged to spend time on it and grasp the underlying concepts and methods.

**For Online Students**

Online students with full-time jobs will take the tests at any certified test taking centers during the scheduled test times. Other option is to come to class to take the test.

All communications will be made either through canvas or through Clemson email IDs; make sure you access this ID regularly. **I must get the choice of testing from online students in 10 days from the start of the semester. Failing this you risk being dropped from the course.**

You can contact me during office hours on phone or any time via email (preferred). You will get a response in usually less than, but maximum up to two business days.

**Course Objective and Course Topics:**

- The objective of this course is to familiarize the students with the philosophy, principles, and applications related to the protection of power systems during abnormal operations.

- The following table gives a break-down of topics to be studied in this course:

Topics	Chapter# from Book
Review <ul style="list-style-type: none"><li>Symmetrical Components</li><li>Fault Analysis</li></ul>	Chapter 4
Introduction to Power System Protection <ul style="list-style-type: none"><li>Philosophy, requirements, and basic structure</li><li>Components – switchgear, relays – their functions, types</li></ul>	Chapter 1 Chapter 1, 5, 6
Principles of Digital Relaying	Handouts
Principles and applications of Line Protection <ul style="list-style-type: none"><li>Distribution lines</li><li>Transmission lines</li></ul>	Chapter 12, notes
Principles and applications of protection of power transformers	Chapter 9
Principles and applications of pilot protection	Chapter 13
Principles and applications of protection of large generators	Chapter 8
Principles and applications of protection of motors	Chapter 11
Principles and applications of protection of Busbars	Chapter 10

**Tests:**

- 2 mid-term tests will be given during class periods. **First test – 2/23/2023, Second test – 4/20/2023.**
- Final exam will be comprehensive – **May 4, 2023, Thursday, 8 am – 10:30 am.**
- Course project will be offered in multiple parts. Project is to be treated as a take-home exam, and no discussion among students is permitted.

*No make-up test is allowed without a doctor's note or official leave from university.*

**Percent Grading:**

35% Mid-term tests  
30% Course Projects  
20% Homework  
15% Final Exam

Note: Canvas may not weigh the scores properly, so students should use this grading scheme to keep track of their grade. All scores will be entered in Canvas.

**Final Grading Policy:**

**If +/- are allowed:**

GRADE	Lower Limit
A	90
A-	87
B+	83
B	80
B-	75

C+	70
C	65
F	<65

If +/- are not allowed:

Grade	Lower Limit
A	90%
B	80%
C	65%
F	<65%

**Grading Policies:** Anticipated grading time for homework or test assignment is within 7 business days of the assignment date. Grade rubric above will be followed in general and round up or down will be strictly at the instructor's discretion. Demonstrated improvement in performance on tests will reflect positively on the rounding process.

**Attendance:** I will take attendance randomly, especially if I see markedly reduced number of students in class. If there is an announcement made in class, it might not be announced on Canvas or email, and you could be at risk of missing something important. You can use the absence notification in Canvas, but that is only for courtesy and does not "excuse" the absence. If you have a true emergency (e.g., you are in the hospital), please contact your instructors or other officials as soon as possible and be prepared to provide proof. *Even if the lectures are recorded for online section, they will not be available to in-class students, unless in case of sickness (doctor's note needed when student returns to class).*

**How to be Successful in this Course:**

- 1) Attend regularly. In the experience of this instructor **there is a strong correlation between irregular attendance and lower grades.**
- 2) Do not start with setting a goal to get a passing grade. This often results in failure.
- 3) Spend time on homework – do it yourself. Homework assignments are designed to clarify your understanding of the material. If you solve them yourself, you are very likely to do well on tests.
- 4) Copying homework solutions from others may get you good grade in homework, but it is almost certain to result in bad test grades. Feel free to drop by during office hours to discuss your difficulties, which means don't wait till the last day to complete homework assignments.

**Communication:** We will be using Canvas as the Learning Management System for this class. My goal is for me and/or the TA to respond to all inquiries in 2 business days. For homework questions, please contact both, me and the TA via email. Be aware that inquiries sent right before an assignment is due may not be answered before the deadline. Please plan accordingly.

**Classroom Etiquette:** Students are expected to be present in class and to arrive to class on time. If you must be late, please enter quietly and find a seat at the back of the room so as to not disrupt other students when you come in. If the instructor is late, students are expected to wait at least 10 minutes before leaving. No tobacco products are permitted in class. No electronic devices may be used in class for purposes not related to the course. Cell phones must be turned off or on

silent and put away for class. Disruptive behaviors, as determined solely by the instructor, will result in dismissal from class.

**Important Dates:**

- Last Day to Drop a Class without a “W”: January 25, 2023.
- Last Day to Drop a Class without a final grade: March 17, 2023.
- Fall break: March 20 - March 24, 2023.
- Final Exam Week: May 1- May 5, 2023.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing [studentaccess@lists.clemson.edu](mailto:studentaccess@lists.clemson.edu), or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen, if at all possible, but there could be a significant wait due to scheduled appointments. Students who have accommodations are strongly encouraged to request, obtain and send these to their instructors [through the AIM portal](#) as early in the semester as possible so that accommodations can be made in a timely manner. It is the student’s responsibility to follow this process each semester.

You can access further information at the [Student Accessibility website](#). Other information is at the university’s [Accessibility Portal](#).

TITLE IX STATEMENT: The Clemson University Title IX statement: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran’s status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This [Title IX policy](#) is located on the Campus Life website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 223 Brackett Hall, 864-656-0620. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

*Clemson University aspires to create a diverse community that welcomes people of different races, cultures, ages, genders, sexual orientation, religions, socioeconomic levels, political perspectives, abilities, opinions, values and experiences..*

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- a. Ensure you are signed up for emergency alerts (<https://www.getrave.com/login/clemson>)
- b. Download the Rave Guardian app to your phone:  
(<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)

- c. Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form.

See the [Undergraduate Academic Integrity Policy](#) website for additional information and [the current catalogue](#) for the policy. For graduate students, see the current [Graduate School Handbook](#) for all policies and procedures.

COPYRIGHT STATEMENT: Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: <https://clemson.libguides.com/copyright>.

EMERGENCY PREPAREDNESS STATEMENT: Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from the Clemson University Police Department. [Visit here for information about safety.](#) Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

1. Ensure you are signed up for [emergency alerts](#)
2. Download the [Rave Guardian app](#) to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)

Learn what you can do to [prepare yourself](#) in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)

**Disclaimer:** The instructor reserves the right to modify this syllabus at any time due to extenuating circumstances or to facilitate improved student learning, including but not limited to COVID-related situations.