

**Clemson University**  
**Holcombe Department of Electrical and Computer Engineering**  
**ECE 8240, Spring 2021**  
**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 226, ZGEC 102 – 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 either provide the contact details of their supervisor who is willing to proctor tests (he/she should send me an email with consent), or take the tests at any certified test taking centers. Other option is to come to class to take the test. If none of these is possible due to the ongoing pandemic, an online exam will be administered, where they will have to keep their video feed on during the entire period for the exam, including scanning and uploading the exam. Student must have a scanner available.

*For students who have chosen to be online due to the ongoing pandemic, it is mandatory to obtain approval from Student Accessibility Services (SAS). The application procedure can be found at <https://clemson.app.box.com/s/62hs9gsjdsppmmlf4e8h6o6y60taxzs6m>. Students with such approval are encouraged to come to class for exams, but if they cannot, an online exam will be administered, where they will have to keep their video feed on during the entire period for the exam, including scanning and uploading the exam. Student must have a scanner available. **Without approval from SAS, students will have to be in class.***

All communications will be done 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.

**Attendance:** Mandatory. A doctor's note or a note from Clemson official will be needed for any absence. In such a case, recorded lecture will be provided to the student who missed a class. Authorized online students who are full-time students must login to the class-meetings through the Zoom invite *synchronously during class hours*. For part-time students or students working full-time, zoom recordings will be provided. In-class students who test positive for Covid-19 will be treated as online students until they are cleared to return to campus. If needed, recorded lectures will be provided to them for the duration of their absence in class.

**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. First test – 2/25/2021, Second test – 4/20/2021.
- Final exam will be comprehensive – May 6, 2021, Thursday, 8 am – 10:30 am.
- Course project will be offered in multiple parts, and will involve use of the RTDS facility at main and Charleston campuses. This will reinforce concepts without the time-pressure of exams. Coding will be required. 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  
25% Course Project  
20% Homework

20% Final Exam

**Final Grading Policy:**  
**If +/- are allowed:**

<b>GRADE</b>	<b>Lower Limit</b>
<b>A</b>	<b>90</b>
A-	87
B+	83
<b>B</b>	<b>80</b>
B-	75
C+	70
<b>C</b>	<b>70</b>
C-	60
<b>F</b>	<b>&lt;70</b>
<b>D</b>	<b>50</b>

**If +/- are not allowed:**

<b>Grade</b>	<b>Lower Limit</b>
A	90%
B	80%
C	70%
F	<70%

**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 a 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 or by emailing [studentaccess@lists.clemson.edu](mailto:studentaccess@lists.clemson.edu). Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors 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 here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

**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.

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. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the Undergraduate Announcements and in the Graduate School Policy Handbook.

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**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 the ongoing pandemic related situations.

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