

Course Outline

1. COURSE INFORMATION

Session Offered	Winter 2017	
Course Name	Power Protection & Maintenance II	
Course Code	ENRTECH 4PP3	
Date(s) and Time(s) of lectures	Fridays, January 4 to April 6, 6:30 pm to 9:30 pm	
Program Name	Bachelor of Technology	
Calendar Description	New generation of digital fault detection systems. Balanced faults, computer-based fault studies, symmetrical components and sequence networks, unbalanced short-circuit and open-circuit faults.	
Instructor(s)		E-Mail: Office Hours & Location:

2. COURSE SPECIFICS

Course Description			
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	39
	L	Laboratory, workshop or fieldwork	8
	T	Tutorial	
	DE	Distance education	
	Total Hours		47
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	9780470057131	Computer Relaying for Power Systems, 2 nd edition, 2009	Arun G. Phadke and James S. Thorp, John Wiley & Sons
	9781439888117	Protective Relaying, Principles and Applications 4 th Edition	J. Lewis Blackburn, Thomas J. Domin CRC Press
	Other Supplies	Source	
Prerequisite(s)			
Corequisite(s)			
Antirequisite(s)			
Course Specific Policies			
Departmental Policies	<p>Students must maintain a GPA of 3.5/12 to continue in the program.</p> <p>In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of "out-of-class" work for every scheduled hour in class. "Out-of-class" work includes reading, research, assignments and preparation for tests and examinations.</p>		

	<p>Where group work is indicated in the course outline, such collaborative work is mandatory.</p> <p>The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor makes an explicit exception.</p> <p>Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class.</p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>	
3. SUB TOPIC(S)		
Week 1	<p>Course organization</p> <p>Advanced Fault Analysis</p> <ul style="list-style-type: none"> • Review of Symmetrical Components • Review of Per Unit System • Transmission Line Mutual Coupling 	<p>Chapter 4, Book 2</p> <p>Chapter 2, Book 2</p>
Week 2	<p>Advanced Fault Analysis – Part II</p> <ul style="list-style-type: none"> • Open Phase Faults • Faults with Two Conductors Open 	Chapter 4, Book 2
Week 3	Motor Protection	Chapter 11, Book 2
Week 4	<p>Generator Protection – Part I</p> <ul style="list-style-type: none"> • Review of Synchronous Generator Basic Operating Principles • Generator Capability Curve • Excitation Systems and Speed Governing Systems • Synchronous Generator Transient and Dynamic Instability • Generator Grounding 	Ch. 8, Book 2
Week 5	<p>Generator Protection – Part II</p> <ul style="list-style-type: none"> • Generator Protection Philosophy • Different Classes of Generator Tripping • Phase and Ground Fault Protection • Loss of Field Protection • Over/Under-excitation Protection • Out-of-step Protection • Under-frequency Protection • Phase Unbalance Protection 	Ch. 8, Book 2
Week 6	<p>Bus Protection</p> <ul style="list-style-type: none"> • Different Bus Configurations • High Impedance Vs Low Impedance Differential Relay <p>High Voltage Capacitor Protection</p> <ul style="list-style-type: none"> • Review of Capacitor Banks • Phase Overcurrent Protection • Phase Overvoltage Protection • Neutral Overvoltage Protection 	<p>Ch. 10, Book 2</p> <p>Ch. 9, Book 2</p>

	<ul style="list-style-type: none"> • Transient Recovery Voltage and Capacitor Bank Switching Failures 	
Mid-term Recess: Monday, February 20 to Sunday, February 26, 2017		
Week 7	Midterm	
Week 8	Power System Special Protection Schemes	Ch. 10, Book 2
Week 9	Design of Digital Relays <ul style="list-style-type: none"> • Historical Background • Advantages of Digital Relays • First Generation of Computer Relaying • Hardware and Software Components of Digital Relays 	Ch. 1, Book 1
Week 10	Introduction to Digital Signal Processing <ul style="list-style-type: none"> • Representing Voltage and Current Signals as Phasors • Fourier Series Representation of Periodic Signals • Fourier Transform of Non-periodic Signals • Discrete Fourier Transform (DFT) • Fast Fourier Transform (FFT) 	Chapter 3, Book 1 Chapter 4, Book 1 Chapter 5, Book 1
Week 11	Applications of Digital Relays - Synchrophasors <ul style="list-style-type: none"> • Wide Area Power System Security Monitoring • Enhancement to Online Power System State Estimation 	Chapter 8, Book 1
Week 12	Protection Against Solar Storms	
Week 13	Course Review	
Classes end: Thursday, April 6, 2017 Final examination period: Tuesday, April 11 to Thursday, April 27, 2016 All examinations MUST be written during the scheduled examination period.		
List of experiments		
Lab 1	Transformer Protection Relay	
Lab 2	Transmission Line Protection Relay	
Lab 3	Induction Motor Protection Relay	
Lab 4	Generator Protection Relay	
Lab 5		
Lab 6		
Mid-term Recess: Monday, February 20 to Sunday, February 26, 2017		
Lab 7		
Lab 8		
Lab 9		
Lab 10		
Lab 11		
Lab 12		
<p>Note that this structure represents a plan and is subject to adjustment term by term. The instructor and the University reserve the right to modify elements of the course during the term. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either</p>		

type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.

4. ASSESSMENT OF LEARNING *including dates*	Weight
Assignments	10
Mid-term test	30
Project	
Labs	20
Final examination (tests cumulative knowledge)	40
TOTAL	100%

Percentage grades will be converted to letter grades and grade points per the University calendar.

5. LEARNING OUTCOMES

1. Perform advanced fault analysis using symmetrical components and Z-matrix method
2. Be able to apply protective relays for motor, generator, bus bar, and shunt capacitor bank protection
3. Be able to design power system special protection schemes
4. Learn how to safeguard power systems against solar disturbances
5. Identify the working principles of digital relays including digital signal processing
6. Understand NERC and NPCC standards on power system protective relaying
7. Identify the key roles of modern power system control centres in wide area system protection

6. POLICIES

Anti-Discrimination

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.

http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf

Academic Integrity

You are required to exhibit honestly and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, located at: <http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf>.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism. E.g. the submission of work that is not own or for which other credit has been obtained
2. Improper collaboration in group work
3. Copying or using unauthorized aids in tests and examinations.

Requests for Relief for Missed Academic Term Work (Assignments, Mid-Terms, etc.)

The McMaster Student Absence Form is an on-line self-reporting tool for **Undergraduate Students** to report absences for:

- 1) Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:
 - Students may submit a maximum of one academic work missed request per term. It is the responsibility of the student to follow up with instructors immediately (within the 3 day period that is specified in the MSAF) regarding the nature of the accommodation. All work due in that time period however can be covered by one MSAF.
 - MSAF cannot be used to meet religious obligation or celebration of an important religious holiday, for that has already been completed or attempted or to apply for relief for any final examination or its equivalent.
- 2) For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has not been used previously in that term:
 - Students must visit their Associate Dean's Office (Faculty Office) and provide supporting documentation.

E-Learning Policy

Consistent with the Bachelor of Technology's policy to utilize e-learning as a complement to traditional classroom instruction, students are expected to obtain appropriate passwords and accounts to access Avenue To Learn for this course. Materials will be posted by class for student download. It is expected that students will avail themselves of these materials prior to class. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail account, and program affiliation may become apparent to all other students in the course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about this disclosure please discuss this with the course instructor. Avenue can be accessed via <http://avenue.mcmaster.ca>.

Communications

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their @mcmaster.ca alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

Turnitin (Optional)

This course will be using a web-based service (Turnitin.com) to reveal plagiarism. Students submit their assignment/work electronically to Turnitin.com where it is checked against the internet, published works and Turnitin's database for similar or identical work. If Turnitin finds similar or identical work that has not been properly cited, a report is sent to the instructor showing the student's work and the original source. The instructor reviews what Turnitin has found and then determines if he/she thinks there is a problem with the work. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/turnitin/students/>

Protection of Privacy Act (FIPPA)

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades and all other personal information at all times.

For example, the submission and return of assignments and posting of grades must be done in a manner that ensures confidentiality.

<http://www.mcmaster.ca/univsec/fipppa/fipppa.cfm>

Academic Accommodation of Students with Disabilities Policy

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information consult McMaster's policy for Academic Accommodation of Students with Disabilities

<http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicAccommodation-StudentsWithDisabilities.pdf>

Students must forward a copy of the SAS accommodation to the instructor of each course and to the Program Administrator of the B.Tech. Program immediately upon receipt. If a student with a disability chooses NOT to take advantage of a SAS accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. <http://sas.mcmaster.ca>

Student Code of Conduct

The Student Code of Conduct (SCC) exists to promote the safety and security of all the students in the McMaster community and to encourage respect for others, their property and the laws of the land. McMaster University is a community which values mutual respect for the rights, responsibilities, dignity and well-being of others. The purpose of the Student Code of Conduct is to outline accepted standards of behavior that are harmonious with the goals and the well-being of the University community, and to define the procedures to be followed when students fail to meet the accepted standards of behavior. All students have the responsibility to familiarize themselves with the University regulations and the conduct expected of them while studying at McMaster University.

http://studentconduct.mcmaster.ca/student_code_of_conduct.html