

Course Outline

1. COURSE INFORMATION

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| Session Offered | Winter 2024 | |
| Course Name | Power Protection & Maintenance II | |
| Course Code | ENRTECH 4PP3 | |
| Date(s) and Time(s) of lectures | Mondays, 7.00 – 10.00 pm | |
| Program Name | Power & Energy Engineering Technology, Bachelor of Technology Program | |
| Calendar Description | Balanced faults, computer-based fault studies, symmetrical components and sequence networks, unbalanced short-circuit and open-circuit faults, power system individual device protection methods, digital fault detection systems. | |
| Instructor(s) | Dr. Nilkamal Fernandopulle, P.Eng. | E-Mail: fernann@mcmaster.ca Office Hours : Mondays by Appointment or Online |

2. COURSE SPECIFICS

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| Course Description | | | |
| Instruction Type | Code | Type | Hours per term |
| | C | Classroom instruction | 39 |
| | L | Laboratory, workshop or fieldwork | 4 |
| | T | Tutorial | |
| | DE | Distance education | |
| | Total Hours | | 43 |
| Resources | ISBN | Textbook Title & Edition | Author & Publisher |
| | 9780470057131 | Computer Relaying for Power Systems, 2 nd Edition, 2009 | Arun G. Phadke & 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 | |
| | PSSE Operation and Application Guides | Siemens website | |
| Prerequisite(s) | ENRTECH 4PM3 and registration in Power and Energy Engineering Technology | | |
| Corequisite(s) | | | |
| Antirequisite(s) | | | |
| Course Specific Policies | <p>All students must have completed WHMIS 1A00 prior to participating in any labs. If WHMIS 1A00 has not been completed, please complete it online by January 9, 2024.</p> <p>The approved calculator for all courses in the B.Tech. Program is the CASIO FX991.</p> <p>The instructor reserves the right to choose the format of any deferred midterms or deferred final exams (i.e., format may be written or oral).</p> | | |

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| | Please note that announcements concerning any type of graded material may be in any format (e.g., announcements made only in class). Students are responsible for completing the graded material regardless of whether they received the announcement or not. | |
| Departmental Policies | <p>Students must maintain a GPA of 3.5/12 to continue in the program. 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 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. SUBTOPIC(S) | | |
| Week 1 | Introduction to Power System Faults <ul style="list-style-type: none"> • Power System Faults - Classification, Causes, Effects • Analysis of a Balanced 3ph Fault • AC Component and DC Component • Asymmetrical Factors and ANSI Standard • Calculation of 3ph Fault Current and MVA level | Ch. 2 & 4 Book 2 |
| Week 2 | Unsymmetrical Faults, Matrix Method for Fault Analysis <ul style="list-style-type: none"> • Review of Symmetrical Components • LG, LL, LLG, Open Phase Fault • Power System Y Matrix and Z Matrix • Use of Z Matrix Method for Fault Analysis | Ch. 2 & 4 Book 2 |
| Week 3 | Calculation of Instant Fault Current Using PSSE Software <ul style="list-style-type: none"> • SCMU Method • ANSI Method • Decay of AC Component for Faults Near Generators • BKDY Method <p>Related Topics</p> <ul style="list-style-type: none"> • Fault Current Control Methods • Ontario Transmission Code on Maximum Fault Currents | PSSE Manual |
| Week 4 | Simulation of Faults Using PSSE and its Impact on Generators <ul style="list-style-type: none"> • Basics of Synchronous Generator Operation • Impact on Generators due to External Faults • Role of Automatic Excitation and Governor Control • Different Data Files needed to Simulate PSSE Transients • Simulation of 3ph Fault • Simulation of LG Fault | PSSE Manual |
| Week 5 | Generator Protection <ul style="list-style-type: none"> • Differential Protection • Stator Phase to Ground Fault Protection Methods • Stator Same Phase Turn to Turn Fault Protection Methods • Field Winding to Ground Fault Protection Methods • Loss of Field Excitation Protection Methods • Out-of-Step Protection Methods • Reverse Power or Motoring Protection Methods • Phase Unbalance Protection Methods • Over/Under-Frequency, Over/Under-Excitation Protection | Ch. 8 Book 2 |

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| Week 6 | Motor Protection <ul style="list-style-type: none"> Basics of Synchronous Motor and Induction Motor Locked Rotor Protection Methods Thermal Detectors and Thermal Protection Methods Phase Failure Protection Methods Phase Reversal Protection Methods Overcurrent Protection Methods Other Protections Used in Motors | Ch. 11 Book 2 |
| Week 7 | Mid-Term Recess | |
| Week 8 | Mid-Term Exam | |
| Week 9 | Bus Bar Protection <ul style="list-style-type: none"> Different Bus Configurations High Impedance Vs Low Impedance Differential Relay High Voltage Capacitor Protection <ul style="list-style-type: none"> Review of Capacitor Banks Phase Overcurrent Protection Phase Overvoltage Protection | Ch. 9 & 10 Book 2 |
| Week 10 | Solid State or Electronic Relays | |
| Week 11 | Digital or Numerical Relays <ul style="list-style-type: none"> Historical Background Advantages of Digital Relays Working Principal <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) | |
| Week 12 | Fundamentals of Special Protection Schemes | |
| Week 13 | Review | |
| Classes end : April 10, 2024 Final examination period: April 12, 2024 to April 25, 2024 All examinations MUST be written during the scheduled examination period. | | |
| List of Experiments | | |
| Lab 1 | Feeder Protection | |
| Lab 2 | Motor Protection | |
| Lab 3 | Transformer Protection | |
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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 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 | 15% |
| Labs | 15% |
| Midterm Exam | 30% |
| 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. Identify the working principle of digital relays
6. Identify the key roles of modern power system control centers in wide area system protection
7. Use PSSE to simulate generator issues that need 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](http://www.mcmaster.ca/policy/General/HR/Discrimination%20Harassment%20Sexual%20Harassment-Prevention&Response.pdf)

Academic Integrity

You are required to exhibit honesty and use ethical behavior 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 behavior 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, usernames 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 of 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/fippa/fippa.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 accommodation 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/StudentsAcademicStudies/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