

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2021
Course Name	Power Quality
Course Code	ENRTECH 4PQ3
Date(s) and Time(s) of lectures	September 7 - December 8, 2021 6:30 pm – 9:30 pm
Program Name	Energy Engineering Technologies – B.Tech
Calendar Description	Introduction to Power Quality; Voltage Sags and Swells; Transient Overvoltages; The Fourier Series; Harmonic Distortion Limits; Measurement of Harmonic Distortion; Harmonic Mitigation and Solutions; Impact of Harmonics on Power Network Systems; Harmonic Frequency Scan Analysis; Harmonic Power Flow.
Instructor(s)	Michael D.N. Dang, Ph.D., P.Eng., FEC E-Mail: mdmikedang@hotmail.com Office Hours & Location:

2. COURSE SPECIFICS

Course Description	Poor power quality can risk disruption to production processes and damage to sensitive equipment. This ten-part course is designed to cover key components in power quality including power quality measurements and problems that can arise from harmonics and voltage fluctuations. It also updates students on current power quality standards, the usual cause and effects of power disturbances and how to resolve them.		
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	30
	L	Laboratory, workshop or fieldwork	4
	T	Tutorial	6
	DE	Distance education	
	Total Hours		40
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	<ul style="list-style-type: none">ISBN-10: 0071761551ISBN-13: 978-0071761550, Edition: 3	Electrical Power Systems Quality. Note: For reference only. Some topics are from published papers.	Roger C. Dugan: McGraw-Hill Companies, Inc., January 2012
	Other Supplies	Source	
Prerequisite(s)	3EP3 , 3MA3		
Corequisite(s)	NA		
Antirequisite(s)	NA		
Course Specific Policies	1) 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). 2) Please note that announcements concerning any types of graded material may be in any format (e.g., announcements may be 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.</p> <p>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	Introduction to Power Quality: Definition; Variation to the AC voltage waveforms; importance of good power quality; consequences of poor power quality; Most common power quality problems; power quality Standards.	
Week 2	Voltage Sags and Swells: Definition; Voltage sags in power systems, sources and sensitivity; causes and effects of voltage swells, measurement and assessment of flickers; Guidelines.	
Week 3	Transient Overvoltages: Origins of switching overvoltages; Transmission line energization; Capacitor bank switching transients; Inrush current surge; back-to-back capacitor bank switching; Transient recovery voltage; Reactor, energization; High frequency transients; Consequences of Overvoltages; Solutions to transient overvoltages.	
Week 4	The Fourier Series: Theory; Symmetrical and orthogonal properties; Fast Fourier Transform; Harmonic and time-domain plots; Synthesizing voltage and current waveforms. Examples in finding Fourier Series of different waveforms.	
Week 5	Harmonic Distortion Limits: THD definition; Harmonic voltage and current distortion limits; Sources of harmonics with examples; Harmonic guidelines	
Mid-term Recess: Monday, October 11 to Friday, October 15, 2021		
Week 7	Test #1 on previous 5-week materials (2 hours): Power Quality; Fourier Series; Harmonic Distortion Limits	
Week 8	Measurement of Harmonic Distortion: Objectives, Point of Common Coupling; Power quality meters; Measuring technique; Measuring Standards.	
Week 9	Laboratory: Measuring voltage and current waveforms and plotting the harmonic spectrum using LabView Program	
Week 10	Harmonic Mitigation and Solutions: Harmonic distortion; Mitigating harmonics in industrial environment; Isolating harmonic loads; line/load reactors; 6-12-18 pulse converters; Fuses; Tuned filters.	

Week 11	Impacts of Harmonics on Power Network Systems: Conductors and cables, transformers; Relays; Wind and solar farms, Electric vehicle chargers; Home appliances	
Week 12	Harmonic Frequency-Scan Analysis: Admittance matrix modeling; Two-port network configuration; The equivalent T- and π - networks; Series and parallel connections in two-port networks; Impedance plot and harmonic resonance; Case studies	
Week 13	Harmonic Power Flow: 3-Ph network admittance matrix modeling; Algorithms for harmonic modeling of transmission lines, transformers, capacitors and reactors, loads and generators; Solving harmonic load flow for each frequency.	
Classes end: Wednesday, December 8, 2021 Final examination period: Thursday, December 9 to Wednesday, December 22, 2021 All examinations MUST be written during the scheduled examination period.		
List of experiments		
A #1	N/A	
A #2	N/A	
A #3	N/A	
A #4	N/A	
A #5	N/A	
Mid-term Recess: Monday, October 12 to Sunday, October 18, 2020		
A #6	N/A	
A #7	N/A	
A #8	N/A	
A #9	N/A	
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		30 %
Mid-term test		20 %
Project		-
Labs		-
Final examination (tests cumulative knowledge)		50 %
TOTAL		100 %
Percentage grades will be converted to letter grades and grade points per the University calendar.		
5. LEARNING OUTCOMES		
Upon successful completion of this course, the students will have reliably demonstrated the ability to:		
1. Learn power quality and its impact on the power network systems		
2. Know harmonic limits, standards and guidelines for use in domestic, commercial and industrial environments		
3. Learn mitigating measures and solutions to reduce harmonic distortion		

4. Learn frequency-scan technique to identify harmonic resonance conditions; and
5. Learn harmonic power flow to analyze the performance of power systems in a harmonic-generated environment.
6. POLICIES
Anti-Discrimination
<p>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.</p> <p>http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf</p>
Academic Integrity
<p>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.</p> <p>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.</p> <p>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.</p> <p>The following illustrates only three forms of academic dishonesty:</p> <ol style="list-style-type: none"> 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.)
<p>The McMaster Student Absence Form is an on-line self-reporting tool for Undergraduate Students to report absences for:</p> <ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Students must visit their Associate Dean's Office (Faculty Office) and provide supporting documentation.
E-Learning Policy
<p>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</p>

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/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 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://judicialaffairs.mcmaster.ca/pdf/SCC.pdf> and <http://www.mcmaster.ca/policy/Students-AcademicStudies/StudentCode.pdf>