ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership

McMaster
University

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2023
Course Name	Measurements and Instrumentation
Course Code	ENRTECH 3MI3
Date(s) and Time(s) of lectures	Saturday 9:00 AM- 11:50 AM
Program Name	Bachelor of Technology
Calendar Description	Transducers, logic circuits, basic electronic devices, and their applications. Calculate/measure the input(s) and output(s) of various systems. Recognize, install, and apply instruments within power plants.
Instructor(s)	Dr. Ahmed AbouArkoub	Phone: 905 5751212/3988 E-Mail: arkouba@mcmaster.ca Office Location: Fennell Campus E231D Office Hours: Saturday 12:00-2::00pm (FF) (online by appointment)
	Mehdi Alimardani	e-mail address: alimarm@mcmaster.ca 905.525.9140 Ext. 20048

2. COURSE SPECIFICS

Course Description	This course will introduce the fundamentals of measurements and the principles of instrumentation in the power industry. Covers the terminology, concepts, principles and computations needed to specify, analyze and maintain instrumentation systems. Practical examples will be used for common Pressure, Level, Temperature, Flow, Final Elements and Safety Systems. Develop mathematical models of physical systems, including mechanical and electrical systems. Study frequency response of a dynamics system. Data acquisition software and hardware will also be discussed.

Code	Type	Hours per term
Instruction Type		
C	Classroom instruction	33
L	Laboratory, workshop or fieldwork	6
T	Tutorial	
DE	Distance education	39
	Total Hours	

Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN: 978-0-8269-3442-0 ISBN: 978-0-8269-3446-8	Instrumentation and Process Control, 6th/7th Lab Manual-online	Franklyn W Kirk, Thomas A W, Philip Kirk, http://avenue.mcmaster.ca
	Other Supplies	**LabVIEW Software and Manuals**	

Prerequisite(s)	ENGTECH 3MA3
Corequisite(s)	
Antirequisite(s)	

Course Specific Policies	All B. Tech. students must complete WHMIS 1A00 (Health and Safety Issues) by September 13th if they haven't already done so. Students who do not pass WHMIS 1A00 will not be able to attend any labs applicable to their course(s) until ENG TECH 1A00 has been passed.
Departmental Policies	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.
	Where group work is indicated in the course outline, such collaborative work is mandatory.
	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.
	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.
	Instructor has the right to submit work to software to identify plagiarism.

3. SUB TOPIC(S)

Module	Activity Type	Assignments	Resources Bank	
Week1	Introduction to Instrumentation-Control & ISA Standard (Instrument Drawing)		-Lecture-1 Introduction-Control and I.S.A Standard (Instrument Drawing)	
			-Chapters 1, 2 & 3	
Week2	Pressure (Pressure Transmitters & Switches, Principles), Instrumentation calibration and operation in processes	-Quiz-1 Intro to Instrumentation	-Lecture-2A Pressure Measurements-part A (Fundamentals), 2B (Mechanical-Devices), and 2C (Electronic-Sensors). -Lecture-3A Fundamentals of Instrumentation Calibration -Lecture-3B Pneumatic Systems	
			-Chapters 9, 10, 11 &12	
Week3	Level Measurements- Fundamentals (Open Vessels)	-Quiz-2 Pressure measurements and calibration	-Lecture-3C Instrumentation Signals and Transmissions -Lecture 4A Level Measurements-Fundamentals -Lecture 4B Level Measurements-Electronic Devices	
			-Chapters 29, 31 & 34 -Chapters 13, 14 & 15	
Week4	Level and Density Measurements-(Closed Vessels, Installation)	-Quiz-3 Level measurement open-tank.	Lecture-4C Level and Density Measurements-Practical	
			-Chapter 17	

Week5	Temperature part 1; (Introduction, Mechanical, Resistance thermometers, etc.).	-**Quiz-4** Level measurement closed-tanks.	-Lecture-5A Temperature Measurements-RTDs Electrical Thermometers -Lecture-5B Temperature-Fundamentals	
			-Chapters 4, 5 & 6	
Week6	Temperature part 2; (TCs, Radiations, etc.)	-**Quiz-5** Temperature measurements-Mechanical/RTD	-Lecture-5C Temperature Measurements-TCs -Lecture-5D Temperature Measurements-Radiations -Temperature TC Calibration-Practical	
			-Chapters 6, 7 & 8	
Week7	Flow measurement-I -Principle and application -Differential flow meters	-**Midterm review** -**Practices A & B** -Review **Quizzes 1 to 5** -**Quiz-6** Temperature measurements-TC	-Lecture-6 Flow Measurements -Midterm review	
			-Chapters 18 & 19	
Week8	Flow measurement-II -Target, and Turbine -Ultrasound, and Mass-flowmeter	-**Midterm Test (Oct 28th)** -**Quiz-7** Flow measurements	-Lecture-6 Flow Measurements	
			-Chapters 20 & 21	
Week9	Final Control Elements - Valves		-Lecture-7 Final Control Elements-Valves	
			-Chapters 39-41	
Week10	Introduction to Industrial Control, system diagrams. -Mathematical modeling of mechanical and electrical systems	-**Quiz-8** Final Control Element-Valves	-Lecture-8A Process Control-Introduction	
Week11	Control of continuous process, (basic theory of P, I & D controllers, open loop systems).	-**Quiz-9 PID** Controller, Open loop system	-Lecture-8B Process Control-Open and Close loop responses -Control System-Matlab simulator, Dynamic Tuning	
			-Chapters 35 & 36	
Week12	Dynamic systems, tuning and Frequency response	-**Final Exam review** -**Quiz-10** Controllers Closed loop system	-Lecture-8B Process Control-Open and Close loop responses -Control System-Matlab simulator, Dynamic Tuning	
			-Chapters 37	
Week13	Industrial Control-Applications and Safety	-**Final Exam review**	-Lecture-9 Industrial Control-applications and Safety -Chapters 46, 47 & 43	
Midterm Recess: Monday, October 9 to Sunday, October 15 Classes end: Wednesday, December 6 Final examination period: Friday, December 8 to Thursday, December 21 All examinations MUST be written during the scheduled examination period				

List of experiments	
Experiment 1	Introduction to LabView Concepts
Experiment 2	Loops, Structures, Arrays, and Clusters
Experiment 3	Waveforms, Graphs, and File I/O
Experiment 4	Basics Data Acquisition (DAQ)
Experiment 5	Advanced Data Acquisition (Gray Box)

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 EARNING *including dates*	Weight
Assignments	10%
Labs	10%
Project	10%
Mid-term Test **(Oct 28th)**	25%
Final Exam	45%
TOTAL	**100%**

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

5. LEARNING OUTCOMES

1. Analyze various process control loops, functions and correctly use Industrial Instrumentation technical terms and symbols.

2. Identify Pressure, Level, Temperature and Flow measuring systems commonly encountered in process control and apply industrial examples.

3. Recognize the application of various pressure, level, temperature, and flow measuring devices. Also, employ the knowledge acquired to calibrate those devices.

5. Analyze mathematical modeling of physical systems, including mechanical and electrical systems

6. Utilize Data acquisition device and software.

6. COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

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 expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.

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. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty: The following illustrates only three forms of academic dishonesty:
- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com, please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

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.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests. http://www.mcmaster.ca/policy/Students-AcademicStudies/Studentcode.pdf

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.