ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership

McMaster University

Course Outline

1. COURSE INFORMATION

Session Offered	Winter 2022	
Course Name	Industrial Networks and Controllers	
Course Code	PROCTECH 4IC3	
Date(s) and Time(s) of lectures	C01: Monday 11:30 AM – 1:20 PM, Thursday 9:30 AM – 10:20 AM L01 Wednesday 8:30AM – 11:20AM L02 Wednesday 1:30PM – 4:20PM	
Program Name	Automation Engineering Technology	
Calendar Description	Corporate and industrial networks, OSI model, Ethernet and TCP/IP, Modbus, Foundation Fieldbus, DeviceNet, PROFIBUS, AS-I, propriety buses protocols and interfaces, distributed I/O, drivers and devices and their implementation in PC and PLC based systems	
Instructor(s)	Dr. Tom Wanyama, P.Eng	E-Mail: wanyama@mcmaster.ca Office Hours & Location: Monday 2:30 PM – 4:30 PM, Online (Microsoft Teams)

2. COURSE SPECIFICS

Course Description

This course introduces the fundaments of communication and industrial networks. In covers the implementation of industrial control systems by integrating PLCs, PCs, sensors, actuators, and remote Input-Output (I/O) modules using industrial networks such as Modbus, DeviceNet, PROFIBUS, Ethernet IP, and PROFINET. In addition, the course covers the theory and practice of implementing sensor, control, and plant level networks. Finally, this course introduces the concepts of horizontal and vertical industrial systems integration, including the integration of industrial and corporate networks, PLC systems, and Distributed Control Systems (DCS); using TCP/IP and Ethernet based industrial networks.

Instruction Type

Code	Type	Hours per term
C	Classroom instruction	38
L	Laboratory, workshop or fieldwork	36
T	Tutorial	
DE	Distance education	
	Total Hours	74

Resources

ISBN	Textbook Title & Edition	Author & Publisher
ISBN:		

Other Supplies	Source
Lecture Notes	Classroom and Avenue to Learn

Prerequisite(s)	PROCTECH 3MC3, 3PL3 and 3SD3 or SMRTTECH 3CC3 and registration in level IV of Automation Engineering Technology
Corequisite(s)	PROCTECH 4CT3
Antirequisite(s)	

Course Specific Policies	**Missed Work:** Make up of missed work will only be allowed if the work is covered by MSAF. **Lab Attendance:** Laboratory attendance is compulsory. A mark of zero will be allocated for missed laboratory experiments. Students shall only attend labs during the time assigned to their lab sections.
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)		
Week 1	**Industrial Automation Systems** Course introduction, Basic Elements of an Automated System, Levels of Automation, Networking: Process Control, Supervisory Control, enterprise Control.	
Week 2	**Fundamentals of Networking** Network communication and components, interoperability and internetworking, ISO-OSI communication reference model and communication protocols.	
Week 3	**Legacy industrial networks** **Modbus serial:** Topics covered include Modbus Overview, Modbus Protocol Structure, Modbus Function Codes, Troubleshooting, Modbus Plus Technical Overview	**Assignment 1:** *Introduction to industrial networks; Due End of Week 3*
Week 4	**Legacy industrial networks** **CANBUS and DeviceNet:** Topics covered include CAN Technical Overview, Application Layers, CANopen, DeviceNet Technical Overview, ODVA,	
Week 5	**Legacy industrial networks** **Profibus:** Introduction to Profibus, Profibus-PA (Process Automation), Profibus-DP (Decentralized Periphery), Network design and configuration	

Week 6	**Ethernet and TCP/IP: 10, 100 & Gigabit Ethernet** Ethernet Networks, TCP and UDP, Internet Layer Protocols, and network design and subnetworking and troubleshooting	
Mid-term recess Monday, February 21 to Sunday, February 27		
Week 7	**Ethernet based industrial networks** Industrial automation using Ethernet IP and Modbus TCP	
Week 8	**Ethernet based industrial networks** ProfiNet, RT, IRT, PROFINET for PA, PROFINET CBA	**Assignment 2:** *TCP/IP; Due end of Week 8*
Week 9	**Ethernet based industrial networks** Electrical Substation Automation Using IEC 61850, GOOSE messaging, and MMS	
Week 10	**Ethernet based industrial networks** Building automation and environment management systems: BACnet, gateways, routers, network architecture and services; Industrial Internet of Things Gateways	
Week 11	**Ethernet and Fieldbus Integration** IO-Link, OSI reference model, wiring, configuration, Ethernet IP and Modbus TCP Gateways	
Week 12	**Ethernet and Fieldbus Integration** FF-H1 and PROFIBUS PA, OSI reference model, wiring, configuration, Ethernet IP and Modbus TCP Gateways	
Week 13	**Course Review** Review of course material in preparation for final examinations.	
Classes end: Tuesday, April 12th 2022 Final Examination Period: Thursday, April 14 to Friday, April 29 All examinations MUST be written during the scheduled examination period.		
List of experiments		
Lab 1	Lab 1 - Remote Access to Lab Equipment and Introductory Equipment Review	
Lab 2	Lab 2 - TCP/IP Utilities	
Lab 3	Lab 3 - Configuration of Device IP Addresses	
Lab 4	Lab 4 - Control Level Networks: Modbus Serial	
Lab 5	Open Lab 1	
Lab 6	Lab Test 1	
Lab 7	Lab 5 – Modbus TCP	
Lab 8	Lab 6 - Ethernet IP Configuration of Communication and Data Access	
Lab 9	Lab 7 - Integration of Modbus and Ethernet IP Devices	
Lab 10	Lab 8 - Configuration of IEC61850 Device and Programming Laboratory	
Lab 11	Open Lab 2	
Lab 12	Lab Test 2	
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	10%
Mid-term test	20%
Labs	20%
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

1. Design industrial networking architecture
2. Select networking technologies for industrial automation applications
3. Understand the fundamentals of data communications
4. Understand and apply IEEE networking standards
5. Follow I/O bus installation and wiring connections guidelines for setting up industrial networks.
6. Design, configure, and program fieldbus networks
7. Program the communication among industrial automation controllers

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.