

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Winter 2024	
<b>Course Name</b>	Industrial Networks and Controllers	
<b>Course Code</b>	PROCTECH 4IC3	
<b>Date(s) and Time(s) of lectures</b>	C01: Mon 11:30 - 1:20pm/ Th 9:30 - 10:20am L01: Wed 8:30 - 11:20am L02: Wed 1:30 - 4:20pm L03: Wednesday 5:30-8:30	
<b>Program Name</b>	Automation Systems Engineering Technology	
<b>Calendar Description</b>	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	
<b>Instructor(s)</b>	Dr. Tom Wanyama, P.Eng	E-Mail: <a href="mailto:wanyama@mcmaster.ca">wanyama@mcmaster.ca</a> Office Hours & Location: Monday 2:30 PM – 3:30 PM, ETB 516
	Mr. Alexandru Barsan	E-Mail: <a href="mailto:barsana@mcmaster.ca">barsana@mcmaster.ca</a>

### 2. COURSE SPECIFICS

<b>Course Description</b>	This course introduces the fundamentals 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.		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	38
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
	<b>Total Hours</b>		74
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>
	<b>Other Supplies</b>	<b>Source</b>	
	Lecture Notes and Videos	<b>Course Website:</b> <a href="http://avenue.mcmaster.ca">http://avenue.mcmaster.ca</a>	
<b>Prerequisite(s)</b>	PROCTECH 3MC3, 3PL3 and 3SD3 or SMRTTECH 3CC3 and registration in level IV of Automation Engineering Technology		
<b>Corequisite(s)</b>	PROCTECH 4CT3		
<b>Antirequisite(s)</b>	N/A		

<p><b>Course Specific Policies</b></p>	<p><b>Missed Work:</b> Make up of missed work will only be allowed if the work is covered by MSAF.</p> <p><b>Lab Attendance:</b> 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.</p> <p><b>Reviewing Test Marks:</b> Tests may be resubmitted to the instructor for re-mark up to one week after the test grade has been uploaded. Students must submit a detailed written description of the marking problem regarding their submission. However, the instructor has the right to remark the test in its entirety.</p> <p><b>Educational Materials:</b> The educational materials developed for this course, including, but not limited to, lecture notes and slides, handout materials, examinations and assignments, and any materials posted to Avenue, are the intellectual property of the course instructor. These materials have been developed for student use <b>only</b> and they are <b>not</b> intended for wider dissemination and/or communication outside of a given course. Posting or providing unauthorized audio, video, or textual material of lecture content to third-party websites violates the instructor’s intellectual property rights, and the Canadian Copyright Act. Failure to follow these instructions may be in contravention of the university’s Code of Student Conduct and/or Code of Academic Conduct, and will result in appropriate penalties. Participation in this course constitutes an agreement by all parties to abide by the relevant University Policies, and to respect the intellectual property of others during and after their association with McMaster University and Mohawk College.</p>
<p><b>Departmental Policies</b></p>	<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><u>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.</u></p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>
<p><b>3. SUB TOPIC(S)</b></p>	
<p>Week 1 Jan 8 - 12</p>	<p><b>Industrial Automation Systems</b>                  Course introduction, Basic Elements of an Automated System, Levels of Automation, Networking: Process Control, Supervisory Control, enterprise Control.</p>
<p>Week 2 Jan 15 - 20</p>	<p><b>Fundamentals of Networking</b>                  Network communication and components, interoperability and internetworking, ISO-OSI communication reference model and communication protocols.</p>

Week 3 Jan 22 - 27	<b>Legacy industrial networks</b> <b>Modbus serial:</b> Topics covered include Modbus Overview, Modbus Protocol Structure, Modbus Function Codes, Troubleshooting, Modbus Plus Technical Overview	<b>Assignment 1: Fundamentals of industrial networks and controllers</b>  <u>Due in Week 4</u>
Week 4 Jan 29 - Feb 2	<b>Legacy industrial networks</b> <b>CANBUS and DeviceNet:</b> Topics covered include CAN Technical Overview, Application Layers, CANopen, DeviceNet Technical Overview, ODVA,	
Week 5 Feb 5 - 9	<b>Legacy industrial networks</b> <b>Profibus:</b> Introduction to Profibus, Profibus-PA (Process Automation), Profibus-DP (Decentralized Periphery), Network design and configuration	
Week 6 Feb 12 - 16	<b>Ethernet and TCP/IP: 10, 100 &amp; Gigabit Ethernet</b> Ethernet Networks, TCP and UDP, Internet Layer Protocols, and network design and subnetting and troubleshooting	
Week 7	Midterm Recess: February 19 - 24	
Week 8 Feb 26 - Mar 1	<b>Ethernet based industrial networks</b> Industrial automation using Ethernet IP and Modbus TCP	
Week 9 Mar 4 - 9	<b>Ethernet based industrial networks</b> ProfiNet, RT, IRT, PROFINET for PA, PROFINET CBA	
Week 10 Mar 11 - 16	<b>Ethernet based industrial networks</b> Electrical Substation Automation Using IEC 61850, GOOSE messaging, and MMS	
Week 11 Mar 18 - 23	<b>Ethernet based industrial networks</b> Building automation and environment management systems: BACnet, gateways, routers, network architecture and services; Industrial Internet of Things Gateways	
Week 12 Mar 25 - 29	<b>Ethernet and Fieldbus Integration</b> IO-Link, OSI reference model, wiring, configuration, Ethernet IP and Modbus TCP Gateways	
Week 13 Apr 1 - 5	<b>Ethernet and Fieldbus Integration</b> FF-H1 and PROFIBUS PA, OSI reference model, wiring, configuration, Ethernet IP and Modbus TCP Gateways	
Week 14 Apr 8-10	<b>Course Review</b> Review of the course	
<b>Classes end: Wednesday, April 10<sup>th</sup> 2024</b>		
Final Examination Period: Friday, April 12 to Thursday, April 25 All examinations <b>MUST</b> be written during the scheduled examination period.		
<b>Experiential Learning Activities</b>		
Lab 1	Introductory Equipment Review	
Lab 2	TCP/IP Utilities and Configuration of Device IP Addresses	
Lab 3	Modbus Serial and Modbus TCP	
Lab 4	Ethernet IP Configuration of Communication and Data Access	
Lab 5	Configuration of IEC61850 Device and Programming Laboratory	
Lab 6	Open Lab	
Lab 7	<b>Lab Test</b>	
Lab 8	Lab Project: Integration of Modbus Serial, Modbus TCP and Ethernet IP Devices	
Lab 9	Lab Project Work	

Lab 10	Lab Project Work
Lab 11	Lab Project Work
Lab 12	<b>Lab Project Presentation and Demonstration (Project report and demonstration video)</b>

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.

*This lecture schedule is based upon current university and public health guidelines and may be subject to changes during the term. Any changes to the schedule or course delivery will be communicated on the course announcements section on Avenue to Learn. Please check the announcements prior to attending class.*

<b>4. ASSESSMENT OF LEARNING *including dates*</b>	<b>Weight</b>
Active Learning Activities	10%
Assignments	10%
Mid-term test	20%
Labs and Lab Project	30%
Final examination (tests cumulative knowledge)	30%
<b>TOTAL</b>	<b>100%</b>

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](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](http://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](mailto: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.