ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership

McMaster
University

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2020
Course Name	Industrial System Components and Integration
Course Code	PROCTECH 4AS3
Date(s) and Time(s) of lectures	C01: Monday 4:30 PM – 6:20 PM, Wednesday 11:00 AM – 12:00 AM L01 Friday 12:30PM – 3:20PM L02 Friday 8:30AM – 11:20AM
Program Name	Automation Engineering Technology
Calendar Description	This course covers advanced sensor and actuator technology, robotics and vision systems, automated workcell, flexible manufacturing systems, computer integrated manufacturing. Hardware and software integration issues, when and how to automate, OPC and HMI.

Instructor(s)	C01: Tom Wanyama	E-Mail: wanyama@mcmaster.ca Office Hours & Location: Monday 12:30 PM – 2:30 PM, Online (Microsoft Teams)
	L01: Marcin Magolon L02: Marcin Magolon	E-Mail: magoloms@mcmaster.ca

2. COURSE SPECIFICS

Course Description	The ability to integrate various industries that affect manufacturing using computer systems has resulted into a new manufacturing paradigm generally referred to in literature as Industry 4.0, Digital Industry or Industrial Internet of Things (IIoT). This paradigm seeks to leverage the potential optimization in production and logistics caused by increased and integrated industrial automation, intelligent system monitoring, and autonomous decision-making that is supported by real-time or almost real-time communication at all levels. This course covers the network technologies that support system integration of process/manufacturing automation, building automation, environment management, as well as energy management and electricity systems automation (smart grid systems). In other words, the course covers the network (hardware and software, including NetDDE, OPC, and SCADA Systems) infrastructure of IIoT. Moreover, the course covers other IIoT infrastructure components such as smart sensors and actuators, as well as Artificial Intelligence based control systems. At the operational level of Industry 4.0, this course covers the use of robotics and vision systems in automated workcells, flexible manufacturing systems, computer integrated manufacturing, and industrial safety systems.

Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	37
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
		Total Hours	

Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN:		
	Other Supplies	**Source**	
	Lecture Notes	Virtual Classroom and Avenue to Learn	
Prerequisite(s)	PROCTECH 4IC3 , 4IT3 ; ENGTECH 4EE0 and registration in level IV of Automation Engineering Technology program		
Corequisite(s)			
Antirequisite(s)			
Course Specific Policies			
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	**Introduction** Classical industrial automation systems, Industry 4.0 concepts: Internet of Things and Industrial Internet of Things, Cyber Physical Systems.	
Week 2	**Integration of Industrial Systems using Fieldbuses (Review)** Review of Ethernet and other Industrial Fieldbuses, Role of Ethernet in Industry 4.0 industrial integration	
Week 3	**Integration of Industrial Systems using OPC** OPC support technologies/web technologies, DDE, COM CORBA Web Services	
Week 4	**Integration of Industrial Systems using OPC** Legacy systems, OPC support technologies, OPC Data Access, OPC Alarms and Events, PC Unified Architecture.	
Week 5	**Integration of Industrial Systems using OPC**	

	OPC as an integration tool, Clients and Servers configuration, Using OPC to Support IIoT (Data Hub) and SCADA systems, HMI	
Week 6	**Smart Sensors and Actuators** Smart sensors and actuators, Internet of Things, Sensor networks	
Week 7	**Smart Sensors and Actuators** MQTT, Industrial applications of sensor networks, Integration of IoT and IIoT.	
Week 8	**Advanced control systems based on Artificial Intelligence** Components of AI systems, Diagnostic AI systems, Knowledge Based Systems, Expert System, introduction to Fuzzy logic	
Week 9	**Advanced control systems based on Artificial Intelligence** Biological Neural Networks, Artificial Neural Networks-ANN - Feed forward net, Training, Using ANN in control systems	
Week 10	**Advanced control systems based on Artificial Intelligence** Machine and plant wide optimization using intelligent systems control, Use of AI in IIoT.	
Week 11	**Safety Standards & System Integration** Industrial Safety standards: IEC61508, IEC 61511, SIL	
Week 12	**Safety Standards & System Integration** Implementation of Integrated safety systems, OPC & SIS	
Week 13	**Course Review and Project Presentation** Review of course material in preparation for final examinations. Project presentation for the PROCTECH6AS3 course projects	
Midterm Recess: Monday, October 12 to Sunday, October 18 Classes end: Wednesday, December 9 Final examination period: Thursday, December 10 to Wednesday, December 23 All examinations MUST be written during the scheduled examination period.		

List of experiments

Lab 1	Servo Motor Control and Setup
Lab 2	PLC Servo Motor Control Integration
Lab 3	Open Lab
Lab 4	Lab Quiz
Lab 5	OPC Connection: KepServer and Labview
Lab 6	OPC AE & HDA
Lab 7	Open Lab
Lab 8	Lab Test

Lab 9	Lab Project

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	20%
Mid-term test	15%
Labs	30%
Final examination (tests cumulative knowledge)	35%
TOTAL	100%

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

5. LEARNING OUTCOMES

1. Understand the concepts of systems integration as applied to Industrial Internet of Things (IIoT)
2. Identify hardware and software requirements for automation system integration and be able to offer solutions.
3. Use industry standard software solutions such as DDE, OPC (including COM & DCOM), web services, HMI, and APIs to integrate automation systems.
4. Specify network systems for computer integrated manufacturing as related to plant wide automated system integration, including the integration of process, manufacturing, building and electrical substation automation systems, and Industrial Internet of Things.
5. Implementation machine and plant wide intelligent optimization systems based on Fuzzy Logic and Neural Networks
6. Apply process and machine safety standards in the design, integration, and maintenance of industrial automation systems.

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.