

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2015	
Course Name	Advanced System Components and Integration	
Course Code	PROCTECH 4AS3	
Date(s) and Time(s) of lectures	Tuesday 1:30 PM – 3:20 PM, Thursday 5:30 PM – 6:20 PM	
Program Name	Process Automation 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)	Tom Wanyama	E-Mail: wanyama@mcmaster.ca Office Hours & Location: Thursday 8:30 AM – 10:30 AM in Room ETB206

2. COURSE SPECIFICS

Course Description	The main objective of this course is to teach students the concepts of computer integrated manufacturing. 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 Artificial Intelligence based control systems. Other topics covered include the use of wireless technology in automation systems, safety systems, and organizational approach to automation.		
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	39
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
	Total Hours		75
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN: 978-0-9948503-0-0	A Practical Approach to Industrial System Integration	Author: Tom Wanyama publisher: IAA
	Other Supplies	Source	
	Class Notes	Classroom and Avenue to Learn	

Prerequisite(s)	PROCTECH 4IC3 , 4IT3 ; ENG TECH 4EE0 and registration in level IV of Process Automation Technology.	
Corequisite(s)		
Antirequisite(s)		
Course Specific Policies	<p><i>Attendance: Laboratory attendance is compulsory. A mark of zero will be allocated for missed laboratory experiments.</i></p> <p><i>Students shall only attend labs during the time assigned to their lab sections. Make up shall only be allowed if the missed work or lab is covered by MSAF.</i></p> <p><u>Students who do not do the lab quiz shall not be allowed in the laboratory, and shall not be allowed to make up such missed lab.</u></p> <p><i>Late Submissions: Late testes and quizzes shall not be allowed. Late lab reports and assignments will result in 10% reduction in the assigned marks for each day the work is late.</i></p> <p><u>Laboratory Safety Policy: The students must follow the departmental safety policy. The students not following the safety policy will not be allowed to work in the laboratory and will not be allowed to make up such missed labs.</u></p>	
Departmental Policies	<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>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 & Web Technologies Topics: Introduction, Application Protocols, Standards and Web Services, Communication Protocols, ISO Communication Reference Model, TCP/IP Protocol, Using Ethernet to Integrate Industrial Systems.	
Week 2	Automation Using IEC 61850 Topics: Introduction to Power system operation and Control, Legacy Electricity Data System, IEC61850 Standard	
Week 3	OPC Foundations & Technology Topics: Introduction, legacy systems, OPC support technologies, OPC Data Access, OPC Alarms and Events, Using OPC to Support IIoT (Data Hub).	
Week 4	OPC Foundations & Technology OPC Batch, OPC Unified Architecture, OPC and Substation automation, HMI, SCADA.	

Week 5	Profinet Topics: Introduction Profinet controllers and I/O, Diagnostics, RT, IRT, Redundancy. PROFINET for PA, PROFINET CBA	
<i>Mid-term recess (Monday, October 12 to Saturday, October 17)</i>		
Week 6	Building Automation Systems Topics: BACnet, LONworks, gateways, Routers, Network, Architecture, services, Using OPC to Integrate BACnet with other Industrial Automation Protocols to form IloT.	
Week 7	Flexible Manufacturing Topics: Material movement and positioning. Manufacturing Flexibility, FMS Features, FMS Priority, Planning and Control Hierarchy, Generic Control Model, System Design, Scheduling and Control	
Week 8	Artificial Intelligence & Fuzzy Logic Topics: Components of AI systems, Diagnostic AI systems, Knowledge Based Systems, Expert System, Use of AI in IloT.	
Week 9	Neural Network Control Systems Topics: What are Neural Networks?, Biological Neural Networks, Artificial Neural Networks-ANN - Feed forward net, Training	
Week 10	Wireless Systems Topics: Overview of wireless technologies, factors for industrial application, design consideration, Implementation, security considerations	
Week 11	Advanced Sensors and Actuators Topics: Pneumatic and Hydraulic Systems , Piezoelectric Motors, RFID sensors	
Week 12	PC in Automation Topics: PCI Cards, Devicenet Scanner, Profibus Scanner, ApplicomIO, EtherCAT, HMI, SCADA Systems, IloT.	
Week 13	Safety Standards & System Integration Topics: IEC61508, IEC 61511, Integrated safety, OPC & SIS	
Classes end – Tuesday December 8, 2015 Final examination period: Wednesday December, 9, 2015 to Tuesday, December 22, 2015 All examinations MUST BE written during the scheduled examination period.		
List of experiments		
Lab 1	IloT Lab 1A: Configuration of Ethernet IP Devices	
Lab 2	IloT Lab 1B: Ethernet IP Configuration of Communication and Data Access	
Lab 3	IloT Lab 2A: Configuration of IEC61850 Device and Programming Laboratory	
Lab 4	IloT Lab 2B: IEC 61850 GOOSE Messaging Laboratory	
Lab 5	IloT Lab 3A: OPC Server Configuration Laboratory	
<i>Mid-term recess (Monday, October 12 to Saturday, October 17)</i>		
Lab 6	IloT Lab 3B – OPC Data Access and HMI	
Lab 7	IloT Lab Test	
Lab 8	Machine Integration (MI) Lab 1: Servo Motor Control Via Direct PC Connect to Motion Control Card 1	
Lab 9	MI Lab 2: PLC Servo Motor Control Integration	
Lab 10	MI Lab 3: PLC Servo Motor Control Via Programmable Terminal	
Lab 11	MI Lab 4: Direct Vision System Setup and Control	

Lab 12	MI Lab Test
<p>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.</p>	
4. ASSESSMENT OF LEARNING *including dates*	Weight
Assignments and Quizzes (Weekly)	10%
Mid-term Test (Date to be determined)	15%
Project (Starts in the fourth week. Report and Presentation last Friday of classes)	15%
Lab Reports, Lab Tests, and Quizzes (Quizzes are weekly)	25%
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. Identify hardware and software issues for system integration in process and manufacturing automation and be able to offer solutions.	
2. Use engineering software tools such as VB & C++, .NET, NetDDE, OPC (including COM & DCOM), web services, HMI, DLLs and APIs.	
3. Specify hardware and software components and functions of advanced systems such as robotics and vision, automated work cells, flexible manufacturing systems, and computer integrated manufacturing as related to plant wide automated system integration and IIoT.	
4. Implementation of Fuzzy Logic and Neural Network Control Systems, and identify advantages, and disadvantages of such controllers.	
5. Select state-of-the art advanced sensors and actuators for process and manufacturing automation systems.	
6. Describe and apply wireless standards and applications used in industrial automation projects.	
7. Apply process and machine safety standards in the design, integration and maintenance of process automation systems.	
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/Anti-Discrimination%20policy.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.)

The McMaster Student Absence Form is a self-reporting tool for **Undergraduate Students** to report absences that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period.

You may submit a maximum of 1 Academic Work Missed requests per term. It is YOUR responsibility to follow up with your Instructor immediately regarding the nature of the accommodation.

If you are absent more than 3 days or exceed 1 request per term you **MUST** visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation.

This form should be filled out immediately when you are about to return to class after your absence.
<http://www.mcmaster.ca/msaf/>

E-Learning Policy

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 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>