

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Fall 2017	
<b>Course Name</b>	Instrumentation & Control	
<b>Course Code</b>	Proc Tech 2IC3	
<b>Date(s) and Time(s) of lectures</b>	Tuesday 1:30 to 2:30pm Thursday 11:30 to 1:30pm	
<b>Program Name</b>	Automation Engineering Technology	
<b>Calendar Description</b>	<p>This course covers common pressure, level, temperature and flow measuring systems that provide the basis to specify, design, construct, test and tune a control loop using a PID controller. A distributed control system is also introduced.</p> <p>Lectures (three hours), one lab (three hours); one term</p>	
<b>Instructor(s)</b>	Dr. Ahmed Abou-Arkoub  Rakesh Sharma	E-Mail: <a href="mailto:arkouba@mcmaster.ca">arkouba@mcmaster.ca</a> Office Hours & Location: Monday 1:30am to 2:30pm, E231D Fennell Campus (appointment). Email: <a href="mailto:rakesh.sharma@mohawkcollege.ca">rakesh.sharma@mohawkcollege.ca</a>

### 2. COURSE SPECIFICS

<b>Course Description</b>	<p>This course covers the terminology, concepts, principles and computations used by engineers and technicians to specify, analysis and maintain instrumentation and control systems. It emphasizes practices in industry so that students learn what aspects of plant design and control are critical.</p> <p>Practical examples have been used for many common pressure, level, temperature and flow measuring systems. Approaches are presented for measurement selection, process/modification, control structure design and algorithm tuning to achieve good performance over a range of operation conditions. The sequence of the topics builds the student's ability to specify, design, construct, test and tune a control loop using a PID controller in multi-loop control design.</p>		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	39
	L	Laboratory, workshop or fieldwork	39
	T	Tutorial	
	DE	Distance education	
	<b>Total Hours</b>		78
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>
	0-8269-3423-4	INSTRUMENTATION	Franklyn W. Kirk, Thomas A. Weedon, Philip Kirk,
		INSTRUMENTATION AND PROCESS CONTROL	Online Lab Manual, A. Abou-Arkoub, <a href="http://avenue.mcmaster.ca">http://avenue.mcmaster.ca</a>
	<b>Other Supplies</b>	<b>Source</b>	
<b>Prerequisite(s)</b>	ENG TECH 1MT3		
<b>Corequisite(s)</b>	PROC TECH 2EE3		
<b>Antirequisite(s)</b>			
<b>Course Specific Policies</b>	At the beginning of each semester, instructors will clearly indicate to students, in writing, the process by which final course grades will be placed on each test,		

	<p>assignments, etc., leading to the final course grade determination. Factors which will influence "professional judgement" must be identified and their impact must be stated.</p> <p><b>ATTENDANCE:</b> Regular attendance is expected for all classes. Aside from the obvious benefits to regular attendance, you are responsible for knowing test dates, assignment due dates, class changes, and other announcements made during class. Although classes missed due to illness and other extenuating circumstances are often unavoidable, absenteeism for these reasons should be kept to a minimum. Attendance in the lab is mandatory, any student that misses more than three lab experiments will receive a "Fail".</p> <p><b>Note:</b> The students must prepare for each lab by studying before attending the lab. The time for experiments is limited and should not be wasted on reading the experiment for the first time in the lab.</p> <p><b>Post-lab reports:</b> The students will work in groups of two. Each student must complete each lab report. However only one report for the group will be marked on alternating basis, i.e if one student's report is marked of that group for one week, the other student's report will be marked for the group the other week.</p>	
<b>Departmental Policies</b>	<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>	
<b>3. SUB TOPIC(S)</b>		
Week 1	Introduction to Instrumentation	Text Chap 1 Course Manual,
Week 2	Pressure (Pressure Transmitters & Switches, Principles)	Text Chap 3 Course Manual,
Week 3	Level & Density - 1 (Hydrostatic Devices, Open Vessels)	Text Chap 4 Course Manual,
Week 4	Level & Density - 2 (Closed Vessels, Other Devices, Installation)	Text Chap 4 Course Manual,
Week 5	Temperature (Heat Transfer, Resistance Thermometer, Non-contact Devices)	Text Chap 2 Course Manual,
Mid-term Recess: Monday, October 9 to Sunday, October 15, 2017		
Week 6	Flow-1 (Turbine, Vortex, Magnetic Flowmeters)	Text Chap 5 Course Manual,
Week 7	Flow-2 (Ultrasonic, Target, Variable Area Flowmeters)	Text Chap 5 Course Manual,
Week 8	Introduction to Process Control	Course Manual, Text Chap 1, 9&12
Week 9	The common elements of system components,(Electric, flow	Course Manual,

	and thermal elements).	Text Chap 9&12
Week 10	T203 Control of continuous process, (basic theory of P, I & D controllers, windup, dynamic responses)	Course Manual, Text Chap 9&12
Week 11	Control loops and systems, part1 (single-element), control action, examples flow temperature control loops.	Course Manual, Text Chap 12
Week 12	Control loops and systems, part2 (Multi-Element1), dynamic response, tuning a single and multi-element loop. DCS System Part I.	Course Manual, Text Chap 9&12
Week 13	Control loops and systems, part3 (Multi-element2), boilers and steam production, boiler drum level controls, safety control. DCS system Part II.	Course Manual, Text Chap 11&12
Classes end: Wednesday, December 6, 2017 Final examination period: Friday, December 8 to Thursday, December 21, 2017 All examinations MUST be written during the scheduled examination period.		
<b>List of experiments</b>		
Lab 1	Lab orientation, lab procedure and Introduction.	
Lab 2	Low Pressure–Manometers and High Pressure-Deadweight Testers Standards	
	High Pressure Standards - Deadweight Testers	
Lab 3	Calibration of Electronic DP Transmitter.	
Lab 4	Hydrostatic level measurement.	
Lab 5	RTDs and R/I Transmitters/Thermocouples Temperature Transmitters.	
Mid-term Recess: Monday, October 9 to Sunday, October 15, 2017		
Lab 6	RTDs and R/I Transmitters/Thermocouples Temperature Transmitters.	
Lab 7	PI Controller Open Loop Dynamic Performance, Analogue PID Controller.	
Lab 8	LabVolt Process System Familiarization, Process Dynamic Characteristics. Process Dynamic Characteristics	
Lab 9	Process Characteristics and Familiarization.	
Lab 10	Feedback Control, Closed Loop Control System, “Pressure-Process”	
Lab 11	Feedback Control, Closed Loop Control System, “Level-Process”.	
Lab 12	DCS/Feedback Control, Closed Loop Control System, “Flow-Process”.	
Lab 13	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>		
<b>4. ASSESSMENT OF LEARNING*including dates*</b>		<b>Weight</b>
Term Test 1		10%
Term Test 2		10%
Lab Reports		25%
Lab Test		10%
Assignments/Project		10%
Final Examination		35%
<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- Describe various process control loops, their functions and correctly use the technical terms and symbols involved in control system.
- 2 - Explain the use of various pressure, level, temperature and flow measuring system commonly encountered in process control.
- 3 - Select, install and use various pressure, level, temperature, flow measuring devices and perform calibration of instruments for such measurements.
- 4 - Demonstrate the mathematical representation of combined control action of a PID controller, calculate input and output signal for various measuring systems.
- 5 - Perform basic process control calculation, explain steady-state and dynamic phenomena and use several different tuning strategies to effectively tune a process controller.

## 6. POLICIES

### 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 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.

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.

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>.

The following illustrates only three forms of academic dishonesty:

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 an on-line self-reporting tool for Undergraduate Students to report absences for:

- 1) Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:
  - Students may submit a maximum of one academic work missed request per term. It is the responsibility of the student to follow up with instructors immediately (within the 3 day period that is specified in the MSAF) regarding the nature of the accommodation. All work due in that time period however can be covered by one MSAF.
  - MSAF cannot be used to meet religious obligation or celebration of an important religious holiday, for that has already been completed or attempted or to apply for relief for any final examination or its equivalent.
- 2) For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has not been used previously in that term:
  - Students must visit their Associate Dean's Office (Faculty Office) and provide supporting

documentation.

### **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](mailto: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> and <http://www.mcmaster.ca/policy/Students-AcademicStudies/StudentCode.pdf>