

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Fall 2015	
<b>Course Name</b>	Mechatronics for Vehicle Technology	
<b>Course Code</b>	AUTOTECH 3MV3	
<b>Date(s) and Time(s) of lectures</b>	Tuesdays 1:30pm-2:30pm and Wednesdays 8:30am-10:30am Fridays 8:30am-11:30am Fridays 11:30am-2:30pm Fridays 2:30pm-5:30pm Sept 8, 2015 – Dec 8, 2015	
<b>Program Name</b>	Automotive and Vehicle Technology	
<b>Calendar Description</b>	Sensors and actuators: analysis, selection and implementation. Programmable logic controllers. Ladder logic and sequential programming. Microcontroller analysis, implementation, and programming. Communication interfaces. Case studies of mechatronic systems, simulation, and testing.	
<b>Instructor(s)</b>	Dr. Lucian Balan	Phone: MARC 289-674-0250 ext.59102 E-Mail: Avenue Email Office: MARC 271

### 2. COURSE SPECIFICS

<b>Course Description</b>	Sensors and transducers. Mechanical, pneumatic, and electrical actuators. Programmable logic controllers and micro-controllers. Sensor performance analysis, selection and implementation. System identification; simulation and control. PLC and micro-controller programming. Analog to digital, and digital to analog conversion. Input and output addressing for PLCs and micro-controllers. Communication interfaces. Automotive examples and case studies. Wiring and programming troubleshooting on real-life based applications.		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	40
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
	<b>Total Hours</b>		76
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>
	9780273742869	Mechatronics : Electronic Control Systems in Mechanical and Electrical Engineering (6 <sup>th</sup> edition)	Bolton, W., Prentice Hall
	978-0826912176	Electrical Motor Controls for Integrated Systems (Optional)	Rockis Mazur
	<b>Other Supplies</b>		<b>Source</b>
	Software	CodeWarrior, Omron	
USB flash drive	Students must provide their own USB flash drive (min. 2 GB)		

<b>Prerequisite(s)</b>	AUTOTECH 3AE3, 3CT3 and registration in level III or above of Automotive and Vehicle Technology.	
<b>Corequisite(s)</b>		
<b>Antirequisite(s)</b>		
<b>Course Specific Policies</b>	<ul style="list-style-type: none"> <li>○ E-mail communication for this course is exclusively through Avenue Mail (from student's Avenue account to instructor's Avenue account).</li> <li>○ Students should provide their own <u>USB flash drive</u> with enough storage space available for saving their course work. Students must have the USB flash drive with them at all times during the labs.</li> <li>○ Report submissions for lab work not performed are not accepted. Lab attendance is mandatory for this course. Labs missed due to legitimate reasons must be completed by the student at a time of mutual agreement with instructor before the assignment solution has been posted on Avenue or discussed in class.</li> <li>○ This course will be using a range of software installed in the lab. Students are required to submit their work in the appropriate format and produced with a similar version of the software as the one in the lab. No attempts will be made to mark work submitted in a wrongful format or produced with a different version of the software.</li> <li>○ Project late submissions will be penalized at 10% per day. Project, tests and final examination on this course are time constrained, meaning that both proficiency and speed of completion are evaluated and graded.</li> <li>○ Some work for this course is performed in groups. Students are free to choose their group partners. Students that cannot decide which group to join will be randomly assigned one by the instructor. If the number of students is uneven the instructor will decide if the remaining students will form a smaller group or if they will be rearranged within existing groups.</li> </ul>	
<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	<p>Introduction. Sensors and transducers.</p> <ul style="list-style-type: none"> <li>○ Introduction to mechatronics</li> <li>○ Examples of engineering applications</li> <li>○ Sensors and transducers</li> <li>○ Sensor classification</li> </ul>	Chapter 1, 2
Week 2	Sensors. Digital signals and digital logic	

	<ul style="list-style-type: none"> <li>○ Sensor performance parameters</li> <li>○ Sensor measurements</li> <li>○ Logical gates</li> </ul>	Chapter 2, 5
Week 3	Programmable logic controllers <ul style="list-style-type: none"> <li>○ PLC description, types</li> <li>○ PLC structure, memory, processor</li> <li>○ PLC programming: mnemonics, software (Omron)</li> </ul>	Chapter 21
Week 4	Ladder logic programming <ul style="list-style-type: none"> <li>○ Ladder logic diagrams</li> <li>○ Input / output addressing</li> <li>○ Latching</li> <li>○ Internal memory addresses</li> </ul>	Chapter 21
Week 5	Sequential programming. <ul style="list-style-type: none"> <li>○ Sequential programming</li> <li>○ Graficets and SFCs</li> <li>○ Parallel and simultaneous branching</li> <li>○ Timers and counters</li> </ul>	Chapter 21
<i>Mid-term recess (Monday, October 12 to Saturday, October 17)</i>		
Week 6	<i>Mid-Term Test (2 hours)</i>	
Week 7	Input and output processing. Faults finding <ul style="list-style-type: none"> <li>○ Software based PLC simulators (Omron)</li> <li>○ Enforcing the status of inputs/outputs bits</li> </ul>	
Week 8	Microprocessors and microcontrollers <ul style="list-style-type: none"> <li>○ Microprocessors description, classification</li> <li>○ Microcontrollers structure</li> </ul>	Chapter 17
Week 9	Microcontroller programming. <ul style="list-style-type: none"> <li>○ Port assignment</li> <li>○ Addressing</li> <li>○ Programming</li> </ul>	Chapter 17
Week 10	Microcontroller programming languages <ul style="list-style-type: none"> <li>○ nqBasic programming language</li> <li>○ Subroutines</li> </ul>	
Week 11	Actuators: mechanical <ul style="list-style-type: none"> <li>○ Types of mechanical actuators</li> <li>○ Kinematic mechanisms review</li> <li>○ Revolute or linear motion transfer</li> </ul>	Chapter 8
Week 12	Actuators: electrical, pneumatic <ul style="list-style-type: none"> <li>○ DC and AC motors review</li> <li>○ Stepper motors review</li> <li>○ Solenoids and relays</li> </ul>	Chapter 7, 9
Week 13	<i>Project presentation.</i>	
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.		
<b>List of experiments</b>		
Lab 1, week 1	Basic sensors	
Lab 2, week 2	Advanced sensors	
Lab 3, week 3	PLC 1	
Lab 4, week 4	PLC 2	
Lab 5, week 5	PLC 3 + <i>Project #1 - PLC</i>	
<i>Mid-term recess (Monday, October 12 to Saturday, October 17)</i>		
Lab 6, week 6	<i>Project #1 - PLC</i>	

Lab 7, week 7	Microcontroller 1
Lab 8, week 8	Microcontroller 2
Lab 9, week 9	Microcontroller 3
Lab 10, week 10	<i>Project #2 - microcontroller</i>
Lab 11, week 11	<i>Project #2 - microcontroller</i>
Lab 12, week 12	Pneumatics / Demo project 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
Labs	10
Mid-Term Test	20
Project 1	20
Project 2	20
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. Understand operation and functionality of various types of sensors and actuators.
2. Select, recommend, and implement sensors and actuators for mechatronics application
3. Develop industrial PLCs programs using ladder logic and sequential programming.
4. Design control algorithm and user interface in mechatronics systems with microcontrollers and analog inputs and outputs.
5. Integrate microcontrollers with sensors and actuators in mechatronics applications.
6. Identify, troubleshoot, and fix errors in PLCs or microcontrollers based applications.

#### 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/Anti-Discrimination%20policy.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 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](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>