

## Course Outline

**1. COURSE INFORMATION**

<b>Session Offered</b>	Fall 2017
<b>Course Name</b>	Robotics and Computer Integrated Manufacturing
<b>Course Code</b>	AUTO TECH 4CI3
<b>Date(s) and Time(s) of lectures</b>	Tu 12:30PM-1:30PM MARC 266 Fr 9:30AM-11:20AM MARC 266
<b>Program Name</b>	Automotive and Vehicle Technology
<b>Calendar Description</b>	Computer systems and CIM; NC programming; robotics; material handling, storage and identification; manufacturing planning and systems; flexible manufacturing systems; CAD/CAM, CIM and quality; emerging CIM technologies.
<b>Instructor(s)</b>	Dr. Zhen Gao E-Mail: gaozhen@mcmaster.ca Office Hours & Location: ETB206 Tuesday 8:30 AM – 12:30 PM ETB206 Thursday 3:30 PM – 4:30 PM ETB206 Friday 12:30 PM – 4:30 PM ETB206

**2. COURSE SPECIFICS**

<b>Course Description</b>	This course provides an introduction to the use of robotic systems in automated manufacturing environments. The course develops knowledge in the areas of automation safety and basic robot operation in integrated manufacturing systems. The course covers introduction to robotics, DH table and kinematics for serial and parallel manipulator, robot design and performance optimization, and some advance topics including robot vision and robotic intelligence.		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	37
	L	Laboratory, workshop or fieldwork	39
	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>
	ISBN: 9780201543612	Introduction to Robotics : Mechanics and Control (Optional)	Craig, John J. Prentice Hall PTR, 2004
	ISBN: 978-0133444339	Robotics, Vision and Control (Optional)	Corke, Peter Springer, 2011
	ISBN: 978 - 1439806302	Reverse Engineering : Technology of Reinvention (Optional)	Wang, Wego; CRC Press; 1st edition, 2010
	<b>Other Supplies</b>	<b>Source</b>	
	USB memory stick	Students provide own USB memory stick (min. 2 GB)	
<b>Prerequisite(s)</b>	AUTOTECH 3AE3, 4EC3, ENG TECH 1CP3		
<b>Corequisite(s)</b>			
<b>Antirequisite(s)</b>			
<b>Course Specific Policies</b>	All work must be shown to get full credit.		

	<p>Missed test marks due to legitimate reasons (officially verified by the Faculty of Engineering/B.Tech) will be added to the final examination.</p> <p>Students should provide their own USB memory stick with at least 2 GB storage space available for saving their course work. Students must have the USB memory stick with them at all times during the labs.</p> <p>Assignments should be submitted before the due date posted on Avenue. Students must attend all labs. Assignments completed without in lab participation will not be accepted. Labs missed due to legitimate reasons must be completed at a later time, mutually agreed with the instructor.</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 robotics: history, classification, application, etc.
Week 2	FANUC robots introduction, FANUC robot programming guide
Week 3	Description: Position, orientation, and frame; translation, rotation and homogeneous transformation
Week 4	DH table and forward kinematics for serial manipulator
Week 5	Inverse kinematics for serial manipulator
Mid-term Recess: Monday, October 9 to Sunday, October 15, 2017	
Week 6	Parallel manipulator and kinematics of Delta robot
Week 7	Cartesian space, joint space and working space
Week 8	Performance: stiffness and dexterity
Week 9	Jacobian and path planning for a 2D Planer Robot and dynamics
Week 10	Manipulator mechanism design, design optimization for manufacturing
Week 11	Introduction of robot vision
Week 12	Robot hybrid programming
Week 13	Advances: intelligent robot, learning robot etc
<p>Classes end: Wednesday, December 6, 2017</p> <p>Final examination period: Friday, December 8 to Thursday, December 21, 2017</p> <p>All examinations MUST be written during the scheduled examination period.</p>	
<b>List of experiments</b>	
Lab 0	Safety

Lab 1	Programming task 1: Robot System / Power Up, Jogging & Initial Setup / Error & Fault Recovery
Lab 2	Programming task 2: Tool Frames
Lab 3	Programming task 3: User/Jog Frames
Lab 4	Programming task 4: Motion Instructions
Lab 5	Programming task 5: Copying & Editing Programs
Lab 6	Programming task 6: Branching
Lab 7	Programming task 7: Position Registers
Lab 8	Programming task 8: Macro
Lab 9	Lab Test
Lab 10-12	Practical Project
Lab 13	Extra time
Lab schedule	Some of the labs will be performed on a rotating basis. The actual lab schedule will be provided by the instructor

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
Quizzes and Assignments	5%
Mid-term Tests	23%
Labs and Project	32%
Final examination (tests cumulative knowledge)	40%
<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 and classify exiting robotic equipment used in automated manufacturing. Understand the advantages and limitations of various robotic systems.
2. Become familiar with safety protocols in robotics environment. Learn to safely operate a robot through manual controller.
3. Learn, understand, and apply standard programming commands to serial robot used in packaging and material handling.
4. Understand and apply mathematic calculations for determining the position of robot tool in space.
5. Learn to program and operate standard serial robot used in packaging and manufacturing industry
6. Understand and apply mathematic calculations for tool positioning of industrial serial and parallel robots
7. Understand the fundamental of machine vision and apply image processing technology in real-life
8. Learn, understand, and apply standard commands used in robot operation

#### 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 if 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 **DUE TO MINOR MEDICAL SITUATIONS** 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 (**NORMALLY WITHIN TWO WORKING DAYS**) regarding the nature of the accommodation.

If you are absent **for reasons other than medical reasons**, for 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/fipppa/fipppa.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>