ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership

McMaster University

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2020	
Course Name	Motion Control and Robotics	
Course Code	PROC TECH 3MC3	
Date(s) and Time(s) of lectures	For Lectures (Online): Tu 11:30AM - 12:20PM Th 2:30PM - 4:20PM For Labs (Online): L01 - Mo 8:00AM - 10:50AM L02 - Mo 12:00PM - 2:50PM L03 - Mo 3:00PM - 5:50PM L04 - Mo 6:00PM - 8:50PM	
Program Name	Automation Engineering Technology	
Calendar Description	The course covers robot anatomy and attributes, end effectors, advanced manipulator, robot programming and applications, AC and DC drive systems, digital motion control and image processing.	
Instructor(s)	Dr. Zhen Gao	E-Mail: gaozhen@mcmaster.ca Office Hours & Location: Online Thursday 1:00 PM – 2:30 PM or upon request
	Prabir Biswas	E-Mail: prabir.biswas@mohawkcollege.ca Office Hours & Location: Online, upon request

2. COURSE SPECIFICS

Course Description	This course provides an introduction to motion control and robotic systems. The course develops knowledge in the areas of automation safety, basic robot operation, general robot information, kinematics modelling and control for both serial and parallel robots, and machine vision. It also introduces the student to basic and advanced robot programming concepts through a series of programming tasks. Motion control systems for speed and position in motor drive and robotics applications will be studied. Students who successfully pass related tests will be offered with an industry certificate about Fanuc industrial robot operation and programming.		
Instruction Type	**Code**	**Type**	**Hours per term**
	C	Classroom instruction	37
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
		Total Hours	73
Resources	**ISBN**	**Textbook Title & Edition**	**Author & Publisher**
	ISBN: 9780201543612	Introduction to Robotics: Mechanics and Control	Craig, John J. Prentice Hall PTR

	Other Supplies	Source
Prerequisite(s)	PROCTECH 3CT3, 3SC3	
Corequisite(s)		
Antirequisite(s)		
Course Specific Policies	All work must be shown to get full credit. Missed test marks due to legitimate reasons (officially verified by the Faculty of Engineering/B.Tech) will be added to the final examination. *Specific policy of Labs/Assignments submissions of Online Virtual Labs:* Labs will be conducted online by using related software which is same as regular on-site labs. Completed labs should be uploaded to the lab's drop box before midnight of the due date. Labs missed due to legitimate reasons must be completed at a later time mutually agreed with the instructor.	
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 to motion control and robotics Introduction to Fanuc robotics	
Week 2	Robot axes, singularity, Various frames (world coordinate system, joint space, tool frames, user frames) Positional data, tool centre point	
Week 3	DOF calculation Parallel Robot	
Week 4	Robot axis limits Methods of defining various frames	
Week 5	Homogeneous matrix transformation	
Week 6	Mid-term recess (reading week) Monday, October 12 to Sunday, October 18, 2020	

Week 7	Forward/direct kinematics DH table	
Week 8	Inverse kinematics	
Week 9	Motion programming	
Week 10	Motion programming continued	
Week 11	Jacobian matrix and speed control	
Week 12	Introduction and implementation of machine vison	
Week 13	Artificial Intelligence and its application in motion control and robotics	
Week 14	Final review	

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	Instructions for using FANUC Teach Pendant with Roboguide and Jogging
Lab 2	Tool frame
Lab 3	User Frame and Jog Frame
Lab 4	Robot Programming & Motion Instructions
Lab 5	Copying & Editing Programs
Lab 6	Macro and Looping
Lab 7	Algorithm Design for Tracing Patterns
Lab 8	Introduction and Programming of Image Processing in Matlab
Lab 9	Application of Image Processing
	Lab Test

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	5%
Mid-term tests	25%
Labs	25%
Project	15%
Final examination (tests cumulative knowledge)	30%
TOTAL	**100%**

Percentage grades will be converted to letter grades and grade points per the University calendar.
Note that the percentage distribution of each module may be adjusted.

5. LEARNING OUTCOMES

1. Demonstrate knowledge of the principles of robotics and motion control
2. Comprehend the basic operating principles of machine vision
3. Design and conduct experiments related to industrial robots and interpret data and communicate the results in writing.

4. Describe and classify exiting robotic systems in industry
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. Capable of conducting literature study and working on an open topic or state-of-the-art technology.

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.

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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.