Bachelor of Technology Partnership   McMaster University ENGINEERING | mohawk COLLEGE

Course Outline

1. COURSE INFORMATION	
Session Offered	Fall 2015
Course Name	Motion Control and Robotics
Course Code	PROC TECH 3MC3
Date(s) and Time(s) of lectures	Lecture: We 8:30AM - 9:20AM ETB 235 Fr 1:30PM - 3:20PM ETB 238 Lab: Th 8:00AM - 11:00AM (Session: L01) Mohawk Campus Th 8:00AM - 11:00AM (Session: L02) Mohawk Campus Th 11:00AM - 2:00PM (Session: L03) Mohawk Campus
Program Name	Process Automation 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: ETB206 Monday: 9:30am – 11:30am Wednesday: 9:30am – 11:30am Dr. Jeff Fortuna — E-Mail: fortunjj@mcmaster.ca Office Hours & Location (if applicable)

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 and machine vision. It also introduces the student to basic and advanced programming concepts through a series of programming tasks. This course also covers concepts and principles to describe, analyze and evaluate variable speed drives. Closed loop control systems for current, voltage, speed and position in motor drive and robotics applications will be studied. This will be achieved using several types of drive systems, such as D.C. motors and 3-phase AC motors.

Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	36
	T	Tutorial	
	DE	Distance education	
		Total Hours	72

Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN: 9780201543612	Introduction to Robotics : Mechanics and Control	Craig, John J. Prentice Hall PTR
	ISBN: 0-13-177691-6	Electrical Machines, Drive and Power systems	Theodore Wildi, 4th Edition (Optional)

	Other Supplies	Source
	USB memory stick	Students provide own USB memory stick (min. 2 GB)
Prerequisite(s)	PROCTECH 3CT3, 3PL3, 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 Mitsubishi Robotics Labs:* Students should provide their own USB memory stick with at least 2 GB storage space available for saving their lab work. Students must have the USB memory stick with them at all times during the labs. Each lab is nominally due 2 weeks after the scheduled lab session. Completed labs should be uploaded to the lab's drop box before midnight of the due date. Cell phone videos must be taken of each completed lab and must be uploaded along with the completed code to the dropbox for the lab. Compress the videos as much as possible! Students must attend all labs. 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	
Week 2	DC machine classification and speed control	
Week 3	DC motor drive and control programming	
Week 4	Feedback control of DC motor based system	
Week 5	Digital motion control and Introduction of AC machine	
Mid-term recess (Monday, October 12 to Saturday, October 17)		
Week 6	Advanced robot programming	
Week 7	Basic operation of robot and visualization of typical motion	
Week 8	Overview of robot classifications. Robot Sensors and Systems	
Week 9	Forward kinematics background	
Week 10	Introduction and implementation of Inverse kinematics	
Week 11	Introduction and implementation of Machine vison	
Week 12	Artificial Intelligence and its application in motion control and robotics	

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

	Mitsubishi Robotics Labs
Lab 1	Programming task 0
Lab 2	Programming task 1
Lab 3	Programming task 2
Lab 4	Programming task 3
Lab 5	Programming task 4
	ETB329 Labs
Lab 1	Programming and implementation of DC motor feedback control system
Lab 2	Programming and implementation of servo motion control
Lab 3	Introduction To ABB ACS 800 AC Drive System
Lab 4	Introduction of forward kinematics of robotic arm and inverse kinematics of Delta robot
Lab 5	Introduction and programming of image processing in Matlab

Note that this structure represents a plan and is subject to adjustment term by term.

The labs in two different parts will be performed on a rotating basis. The actual lab schedule will be provided by the instructors.

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	20%
Labs and Projects	40%
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. Demonstrate knowledge of the principles of robotics and motion control.

2. Describe and analyze various speed and position control loops

3. Comprehend the basic operating principles DC motors as well as their characteristics and behaviours.

4. Design and conduct experiments related to electric machines, analyze and interpret data and communicate the results in writing.

5. Describe and classify exiting robotic systems in industry

6. Learn to program and operate standard serial robot used in packaging and manufacturing industry

7. Understand and apply mathematic calculations for tool positioning of industrial serial and parallel robots

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/Anti-Discrimination%20policy.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 of 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. 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