

The University of Western Ontario
Department of Mechanical & Materials Engineering

MME 4452b — Robotics and Manufacturing Automation

COURSE OUTLINE — 2018–2019

**CALENDAR
DESCRIPTION:**

An overview of robotics and manufacturing automation technology and principles. Topics include: automatic production and assembly, sensors, actuators and drives, mechanization of part handling, industrial robots, and vision systems. Emphasis will be on the planning, design and implementation of automation systems. PLCs will be used in the lab section.

PREREQUISITES:

ECE 3374a/b and MME 3380a/b or ECE 3330a/b and ECE 3375a/b or registration in year four of the Integrated Engineering Program.

**ACCREDITATION
UNITS:**

Engineering Science = 75%, Engineering Design = 25%

TOPICS:

- Introduction to industrial automation
- Pneumatics and hydraulics
- Industrial control systems
- Programmable Logic Controller (PLC) programming
- Industrial sensors and actuators
- Parts handling systems
- Industrial robotics
- Machine vision systems
- Industrial networks
- Safety
- Future trends

**LEARNING
OUTCOMES:**

Upon successful completion of this course, students will:

- Identify and describe the basic components of manufacturing automation
- Compare and contrast different types of automated production processes
- Understand and describe the performance and characteristics of industrial robots
- Understand and apply industrial sensors
- Understand and apply electrical, mechanical and pneumatic actuators
- Design and analyse elementary mechanisms for automated machinery
- Understand and program common industrial controllers (PLCs)
- Understand and apply industrial machine vision systems
- Program and operate an industrial robot
- Design, setup and implement pneumatic circuits
- Apply automation principles and concepts to the solution of specific manufacturing challenges and case studies
- Design, implement and test an automated workcell, integrating several technologies

COMPUTING:

Students will have access to the computers and automation equipment available in SEB 1068 (Mechatronics and Manufacturing Automation Laboratory). Access will be restricted to daytime hours, when undergraduate labs are not scheduled.

CONTACT HOURS:

2 lecture hours, 3 laboratory hours per week, half course

TEXT:	None.
REFERENCES:	James A. Rehg, Introduction to Robotics in CIM Systems, 5 th edition, Upper Saddle River, NJ: Prentice Hall, 2003. ISBN 0130602434 Beno Benhabib, <i>Manufacturing: Design, Production, Automation and Integration</i> , New York: Marcel-Dekker, 2003. Mikell P. Groover, <i>Automation, Production Systems, and Computer-Integrated Manufacturing</i> , 2nd Edition, Upper Saddle River, NJ: Prentice Hall, 2001.
UNITS:	SI
EXAMINATIONS AND QUIZZES:	Closed Book. Only simple, non-programmable calculators will be allowed in the final exam.
EVALUATION:	The course grade will be determined as follows:

<i>Description</i>	<i>Weight</i>	<i>Due Date</i>
Individual assignments (Total = 6)	18%	Bi-weekly
Labs (Total = 4)	12%	Bi-weekly
Group Workcell Project	30%	Report due April 9, 2019 Workcell demos during the labs of the week of April 1, 2019
Final Examination (Closed Book)	40%	TBA

Students will be notified of submission deadline dates through OWL.

Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness. Questions that are **descriptive** and **interpretative** in nature require the student to demonstrate his/her knowledge about the topic. These questions are graded using the following marking strategy. A grade of 70% is assigned for an answer that is simply a reiteration or brief interpretation of the information presented during the lectures. A proportionately higher grade is assigned for a thorough presentation or an answer that demonstrates deeper insight into the topic. Answers failing to meet a minimum standard are assigned a proportionately lower grade.

Note that, the efforts of the team on the major project constitute a major component of this course. Each student will be asked to specify the contribution made by each member of the team, including his/herself. Team grades may be adjusted by up to 30% for each student based on self and peer evaluation.

COURSE POLICIES:	To pass the course, the following requirements must be met: <ul style="list-style-type: none"> • A minimum mark of 50% in each lab and assignment, with a minimum average of 60% across all labs and assignments. • A minimum of 50% on the project and on the final exam.
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If these conditions are not met, your final grade cannot be greater than 48%. Students who have failed this course (i.e., final average <50%) must repeat all components of the course.

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- INSTRUCTOR:** Ralph O. Buchal, Ph.D., P.Eng.
Room SEB 2069C; Tel: 611-2111 ext. 88454; rbuchal@uwo.ca
Office hours by appointment.
- ENGLISH:** In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests and examinations for improper use of English. Additionally, poorly written work, with the exception of final examinations, may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.
- In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades assigned to all written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings and the preparation and use of tables and figures.
- All work will be marked first for content* after which a penalty not to exceed the maximum indicated may be applied for lack of proficiency in English and/or presentation.
- ATTENDANCE:** Any student, who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.
- ABSENCE DUE TO ILLNESS OR OTHER CIRCUMSTANCES:** Students should immediately consult with the instructor or program Director if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or program Director regarding how best to deal with the problem. Failure to notify the instructor or program Director immediately (or as soon as possible thereafter) will have a negative effect on any appeal.
- For more information concerning medical accommodations, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf
- For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf
- CHEATING AND PLAGIARISM:** Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is

attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

***POLICY ON
REPEATING ALL
COMPONENTS OF A
COURSE:***

Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

***USE OF
ELECTRONIC
DEVICES:***

Students may use laptops *only* to access the course OWL site and perform course-related activities during lectures and laboratories. Calculator use is permitted during the final examination; students using programmable calculators must clear the device's memory at the beginning of exams. No other electronic devices (e.g., cell phones, MP3 players) may be used during lectures, laboratories or examinations.

***INTERNET AND
ELECTRONIC MAIL:***

Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

ACCESSIBILITY:

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

***SUPPORT
SERVICES:***

Office of the Registrar, <http://www.registrar.uwo.ca/>

Student Development Centre, <http://www.sdc.uwo.ca/>

Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>

USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

NOTE:

The above topics and outline are subject to adjustments and changes as needed.

December 21, 2018

***INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS
OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED***

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic accommodation will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services office if you are in first year) that there are compelling medical or compassionate grounds that can be documented before academic accommodation will be considered. Different regulations apply to term tests, final examinations and late assignments. Read the instructions carefully. (see the 2018 Western [Academic Calendar](#)).

A. GENERAL REGULATIONS & PROCEDURES

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number (please spell your full name).
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a special examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or the counsellors in the Undergraduate Services Office if you are in first year.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office if you are in first year). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

Calendar References: Check these regulations in your 2016 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Absences Due to Illness](#)
[Academic Accommodations for Students with Disabilities](#)
[Academic Accommodations for Religious Holidays](#)
[Course Withdrawals](#)
[Examinations](#)
[Scheduling of Term Assignments](#)
[Scholastic Offences](#)
[Student Medical Certificate](#)
[Engineering Academic Regulations](#)

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. "A" or "F") September 14, 2018
Full courses and full-year half course (i.e. "E", "Y" or no suffix) September 14, 2018
Second term half course (i.e. "B" or "G") January 15, 2019

Drop Deadlines:

First term half course (i.e. "A" or "F"): November 12, 2018
Full courses and full-year half courses (i.e. "E", "Y" or no suffix): November 30, 2018
Second term half or second term full course (i.e. "B" or "G"): March 7, 2019

Undergraduate Services Office:	SEB	2097	Tel: (519) 661-2130	E-mail: engugrad@uwo.ca
Dept. of Chemical and Biochemical Engineering:	TEB	477	Tel: (519) 661-2131	E-mail: cbeugrad@uwo.ca
Dept. of Civil and Environmental Engineering:	SEB	3005	Tel: (519) 661-2139	E-mail: civil@uwo.ca
Dept. of Electrical and Computer Engineering, Software Engineering Mechatronics Engineering	TEB	279	Tel: (519) 661-3758	E-mail: eceugrad@uwo.ca
Dept. of Mechanical and Materials Engineering:	SEB	3002	Tel: (519) 661-4122	E-mail: mmeundergraduate@uwo.ca