

Western University  
Faculty of Engineering  
Department of Electrical and Computer Engineering  
Biomedical Engineering Program

## **ECE-9515/BME-9515 — Advanced Medical Mechatronics Design Course Outline — Winter Semester 2015**

**Description:** This course focuses on the design, development, testing and implementation of mechatronic devices for medical applications. The medical field presents unique challenges for the development of mechatronic devices that can assist in the advancement of more effective and less invasive treatment options. This course will provide the skills required to develop mechatronic devices under the stringent constraints required to deliver surgery and therapy. The focus will be on practical and real applications, identifying the current limits of the technology and highlighting areas for improvement. This course will be especially useful to those students doing research related to the use, development or testing of some aspect of mechatronic devices for clinical applications (including the mechanical design component, sensorization, actuation, software development or guidance).

**Hours:** Thursdays 1:30–4:30 in HSB 35.

**Instructor:** Ana Luisa Trejos, PhD  
Assistant Professor  
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Office hours upon request

**Specific Learning Objectives:** At the end of this course, students should be able to:

- Critically analyze mechatronic devices that have been developed for clinical applications, recognize their limitations and have the ability to propose improvements and solutions.
- Describe the various components that are required to build a mechatronic device for medical use, comprehend the difficulties of their implementation and recognize how these difficulties can be avoided.
- Evaluate an application and identify the requirements that are needed to design and develop a mechatronic device to solve a particular deficiency in the existing technology.
- Design and develop a mechatronic device for clinical applications, create computer models of the device and simulate its performance.
- Evaluate the performance of a mechatronic device and identify the best methods for testing in various lab-based and *in vivo* environments.

**Requisites:** You must be enrolled in a research program related to the field of biomedical engineering. Background in mechanical engineering, design, controls and/or electronics is highly beneficial.

**Course Materials:** There is no required textbook for this course. Any recommended readings will be made available through OWL (Sakai, formerly WebCT).

**Evaluation:** Grades for the course will be determined on the following basis:

Quizzes	30% (6 total, 5% each)
Assignment 1	10%
Assignment 2	20%
Final project	30%
Participation	10%

Failure to complete any of the work will result in a zero being recorded for that assignment or quiz. Quizzes will take place at the beginning of the lesson on the date indicated.

Due dates are nonnegotiable. Assignments are due by the end of the class period on the due date. Late submissions will be penalized 10% per class period (applied as soon as the lesson is over and cumulative on a daily basis).

All submitted work must be of professional quality. Material that is handed in dirty, illegible, or disorganized will be returned to the student for resubmission and the late submission penalty will take effect. An additional penalty of up to 10% of each grade will be applied for poor grammar, incoherence or lack of flow in the written reports.

**How to Succeed in this Course:** This course will be most beneficial to you if you can tie it directly with your graduate research objectives. Talk to the instructor if you wish to identify potential relationships between your research and the objectives of the course.

Class attendance is highly encouraged. Attention to the events happening in each lecture will ensure your understanding of the topics and will allow you to gain the most from the course.

While every student works at a different level, it is the effort placed in each deliverable that ultimately leads to success. Your interest in the course, participation in class by asking relevant questions, and talking to the instructor during office hours will all contribute to your successful completion of the quizzes, assignments and project; you are highly encouraged to make the most of these opportunities.

**Topics:**

- What is mechatronics? Relevance for medical applications and benefits; challenges and limitations – biocompatibility, sterilization and safety
- Design of Medical Devices: mechanical design process; mechanisms; mechanical components; materials (biocompatible materials)
- Actuation Systems: requirements; actuation technologies; selection and integration
- Sensing: requirements; sensing technologies; selection and integration

- Medical mechatronic system integration: data acquisition (sampling and filtering); modeling; control systems; safety
- Testing: laboratory evaluations; statistical analysis; Health Canada and ethics board approval; additional evaluations and clinical trials
- Applications

**Statement of Academic Offences:** Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

[http://www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_grad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf).

All assignments and reports may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in 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>).

**Cheating and Plagiarism:** Students must write their reports 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.

While study groups are encouraged, their proper purpose is not to do the homework assignments, but to help you learn the materials. Each student is responsible for writing up and submitting the assignments. Separate copies of a group-constructed assignment are not acceptable.

**Senate Policy on Prerequisites:** Students are responsible for ensuring that their selection of courses is appropriate and accurately recorded and that all course prerequisites have been successfully completed. If the student does not have the requisites for a course, and does not have written special permission from his or her Dean to enrol in the course, the student may be removed from the course and it will be deleted from the student's record. This decision may not be appealed. A student will receive no adjustment to his or her fees in the event that he or she is dropped from a course for failing to have the necessary prerequisites.

**Use of Electronic Devices Policy:** Turn off all sound for pagers and cell phones. If an emergency might arise during class that requires the use of a cell phone, please sit near the door in order to make a quick exit. Laptops are only permitted for taking in-class notes or assessing relevant materials. No electronic devices will be permitted during the quizzes with the exception of calculators when indicated so by the instructor.

**Missed Quiz Policy:** If a student misses a quiz, it will not be rescheduled. The student must follow the “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled,” and provide documentation to their Department within 24 hours of the missed test. The Department will decide whether to allow the reweighting of the quiz, where reweighting means that the 30% allocated to 6 quizzes will be divided by the other 5 quizzes. If no reasonable justification for missing the quiz can be found, then the student will receive a mark of zero for the quiz.

**Internet/Bulletin Board Policy:** It is the student’s responsibility to read the course website and/or bulletin board and be aware of any information that is posted about the course. If the student fails to act on information that has been posted on these sites and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

**Other Course Policies:** Please make an effort to be in the classroom ready to start at the class start time. Lectures will start promptly and immediate attention will be required from the start. In accordance with university policies, reasonable accommodation will be made to a student’s religious observances and practices due to national origin. If a student is going to miss a quiz for religious reasons, they must inform the instructor at least 48 hours prior to the quiz date or they will be required to write the exam.

Special accommodation for students with disabilities will also be made for those who have been diagnosed as having physical or mental limitations and special needs (unless such accommodations have the end result of fundamentally altering a program or services or placing an undue hardship on the operation of the university). Students with disabilities should contact Services for Students with Disabilities ([www.sdc.uwo.ca/ssd](http://www.sdc.uwo.ca/ssd)) for information regarding accommodations.

**Health and Wellness:** As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. For example, to support physical activity, all students, as part of their registration, receive membership in Western’s Campus Recreation Centre. Numerous cultural events are offered throughout the year. For example, please check out the Faculty of Music web page <http://www.music.uwo.ca/>, and our own McIntosh Gallery <http://www.mcintoshgallery.ca/>. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>. Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at [http://www.health.uwo.ca/mental\\_health/resources.html](http://www.health.uwo.ca/mental_health/resources.html).