

MME 4470b - Medical and Assistive Devices

COURSE OUTLINE 2024-2025

CALENDAR DESCRIPTION: Introduction to the design, development and operation of medical and assistive devices that can improve the quality of human life. Topics include design of assistive, corrective, and diagnostic devices; human factors engineering; biocompatibility of materials; bioelectronics; biosensors; and lab-on-a-chip systems.

COURSE INFORMATION: Instructor: George K. Knopf, PhD, P.Eng.
Room: SEB 3087
Email: gkknopf@uwo.ca

Timetable information is available at <https://draftmyschedule.uwo.ca/>

PREREQUISITES: Completion of the third year of either the Mechanical Engineering, Mechatronics Systems Engineering, **or** Integrated Engineering program.

ACCREDITATION UNITS: Engineering Science = 60%, Engineering Design = 40%

TOPICS:

Medical and assistive devices have evolved rapidly in recent years due to a better understanding of human physiology, availability of bio-compatible materials, advances in integrated electro-mechanical systems, and the introduction of innovative nano/micro technologies. Students will develop the knowledge and skills necessary to adopt an interdisciplinary approach to the design and development medical and assistive devices through the lectures, assignments, in-class seminar and term project. Specific topics include:

1. **Introduction to Medical and Assistive Devices** – History of medical technology; medical device design process; classes of medical devices; government regulations and standards; reliability and safety; mistake-proofing; product recall; medical device failures.
2. **Human Factors** - Human factors engineering; anthropometric data; understanding customer's requirements; principles of Universal Design; assistive technologies; prosthetic limbs.
3. **Components of Medical Devices** - Biocompatibility of materials; medical polymers; physiological measurements; bioelectronic interfaces; integrated lab-on-a-chip (LOC).
4. **Applications** – Mobility assist technology; orthopedic implants; neural prosthesis; circulatory assist device; biosensors; point-of-care devices.

LEARNING OUTCOMES:

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

- Explain the impact of government regulations on the development of new medical technologies (IESE1, **PR2**)
- Describe the role of human factors in medical and assistive device design (PA1, **PR2**)
- Analyze and critically evaluate the function of simple medical and assistive devices (KB3, PA1)
- Describe the scientific and/or engineering principles used by a specific medical or assistive device (KB3, PA1, CS2, LL2)

- Design, construct and evaluate an assistive technology that can improve “quality of life” (D1, D2, ITW2, CS3)

CONTACT HOURS: 2 lecture hours and 2 laboratory hours per week, half course. Note that the laboratory work includes individual self-study and group projects.

TEXT: **Optional:** Kucklick, T.R., (2013), *Medical Device R&D Handbook*. Boca Raton, CRC Press. ISBN # 0-8493-2717-2 (Note: available on-line through UWO Libraries)

Optional: Fries, R.C., (2013). *Reliable Design of Medical Devices*. CRC Press. Boca Raton, CRC Press. ISBN #978-1-4398-9494-1 (Note: available on-line through UWO Libraries)

REFERENCES: Assigned Readings

UNITS: SI

EVALUATION: The course grade will be determined as follows:

Individual Assignments (Total = 3)

Assignment #1	(Due: Feb. 10, 2025)	10%
Assignment #2	(Due: March 3, 2025)	10%
Assignment #3	(Due: March 24, 2025)	10%
In-class Seminar	(Feb. 24 to April 2, 2025)	20%

Term Project

Design Review #1	(Feb. 3, 2025)	5%
Design Review #2	(March 10, 2025)	5%
Prototype & Demonstration	(March 31, 2025)	10%
Technical Report	(Due: April 4, 2025)	30%

Marks will be assigned on method of analysis and presentation, correctness of solution, clarity, and neatness. A proportionately higher grade is assigned for a thorough presentation or a solution that demonstrates deeper insight into the topic. Answers failing to meet a minimum standard are assigned a proportionately lower grade.

CONSULTATION HOURS: By appointment (in-person **or** to be arranged using Zoom within OWL)

USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI): Students may use Generative AI tools/software/apps to assist them in completing assignments and project work. However, students must describe in detail the role that the AI tools played in developing the solution(s) and provide appropriate references to the software tools and/or databases.

General Faculty / University Policies

In the event of contradictions between course-specific policies above and general Faculty / University policies described below, please contact your course instructor for clarification.

- 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 Associate Dean Academic (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean Academic, the student will be debarred from taking the regular examination in the course.
- Missed/Late Accommodation Policy**
1. Students missing a test/assignment/lab or examination you will report the absence by submitting an Academic Consideration Request form through [STUDENT ABSENCE PORTAL](#).
 2. **Documentation must be provided as soon as possible.**
- Exam Accommodation**
1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through [STUDENT ABSENCE PORTAL](#).
 2. Be prepared to provide the Undergraduate Services Office with supporting documentation (below 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, headache, 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 submit an Academic Consideration Request Form through [STUDENT ABSENCE PORTAL](#).
- PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.*
- 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 submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see below 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 Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
 4. Some courses may have built-in flexibility for assignment deadlines or the total number of assignments that will be graded. See course-specific policies for details.
 5. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
- Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).*
- Medical Accommodation**
1. The Academic Consideration Request Form is available through the [STUDENT ABSENCE PORTAL](#).
 2. Requests for academic consideration must include the following components:
 - a. Indication of the course(s) and assessment(s) affected by the request

- b. Medical note, and
 - c. Additional supporting documentation as relevant
3. Requests for academic consideration without a medical note or other supporting documentation may be accepted once per term, per course.
 4. Undocumented absences cannot be used for examinations scheduled by the Office of the Registrar during official examination periods (including take-home final exams and December mid-year exams for full courses) and practical laboratory and performance tests typically scheduled in the last week of the term. Undocumented absences also cannot be used for the “designated assessment” in each course. When flexibility in assessment exists and is clearly stated on the course outline, both undocumented absences and academic consideration requests with documentation may be denied.
 - 5. Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
 6. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Registration.

7. An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade (e.g., “8 of 10 quizzes”). Assessment flexibility must be indicated on the course outline.
8. An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submission timeframe (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

Religious Accommodation

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

Academic Integrity

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit [Academic Integrity Western Engineering](#) for more information

Academic Offences

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.

[Scholastic Discipline for Undergraduate Students](#) & [Cheating, Plagiarism and Unauthorized](#)

[Collaboration: What Students Need to Know](#)

Students must write their reports, 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

Faculty of Engineering AI Policy

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.

GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

Use of English Policy

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 except for the final examination 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.

Accessibility

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the [Accessibility Western University](#) for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit [Academic Support & Engagement -Academic Accommodation](#).

Inclusivity, Diversity, and Respect

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the [Office of Equity, Diversity and Inclusion](#).

Health and Well-Being

- [Health & Wellness Services – Students](#) - Offers appointment-based medical clinic for all registered part-time and full-time students.
- [Mental Health Support](#) - Provides professional and confidential services, free of charge, to

students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.

- [Crisis Support](#) - For immediate assistance, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click [here](#).
- [Gender-Based Violence and Survivor Support](#) - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Links

- [WESTERN ACADEMIC CALENDAR](#)
- [ACADEMIC RIGHTS AND RESPONSIBILITIES](#)
- [ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS](#)
- [UNIVERSITY STUDENTS' COUNCIL \(USC\) - SERVICES](#)
- [IMPORTANT DATES AND DEADLINES](#)
- [ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS](#)
- [ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS](#)
- [SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS](#)
- [STUDENT FORMS](#)
- [OFFICE OF THE REGISTRAR](#)
- [RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES \(SYLLABI\)](#)
- [ACADEMIC APPEALS](#)
- [STUDENT ABSENCE PORTAL](#)

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 13, 2024
Full courses and full-year half course (i.e. "E", "Y" or no suffix)	September 13, 2024
Second term half course (i.e. "B" or "G")	January 14, 2025

Drop Deadlines:

First term half course without penalty (i.e. "A" or "F")	November 12, 2024
Full courses and full-year half courses without penalty (i.e. "E", "Y" or no suffix)	December 2, 2024
Second term half or second term full course without penalty (i.e. "B" or "G")	March 7, 2025

Contact Information:

Undergraduate Services Office:
Phone: 519-661-2130

SEB 2097
E-mail: engugrad@uwo.ca

Mechanical Engineering:
Phone: 519-661-4122

SEB 3002
E-mail: mmeundergraduate@uwo.ca

Chemical & Green Process Engineering:
Phone: 519-661-2131

TEB 477
E-mail: cbeugrad@uwo.ca

Civil Engineering:
Phone: 519-661-2139

SEB 3005
E-mail: civil@uwo.ca

Computer, Electrical, Mechatronic Systems & Software Engineering TEB 279
Phone: 519-661-3758

E-mail: eceugrad@uwo.ca

Integrated Engineering
Phone: 519-661-6725

ACEB 2410
E-mail: engceli@uwo.ca

Office of the Registrar/Student Central
Phone: 519-661-2100

WSSB 1120