

MME 4470b - Medical and Assistive Devices

COURSE OUTLINE 2023-2024

**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:**

At the end of the course, each student will be able to:

- 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. 12, 2024)	10%
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Assignment #2	(Due: March 4, 2024)	10%
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Assignment #3	(Due: March 25, 2024)	10%
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In-class Seminar	(Feb. 26 to April 5, 2024)	20%
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Term Project

Design Review #1	(Feb. 5, 2024)	5%
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Design Review #2	(March 11, 2024)	5%
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Prototype & Demonstration	(April 8, 2024)	10%
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Technical Report	(Due: April 8, 2024)	30%
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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 demonstrated 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)

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.

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.

CHEATING: University policy states that cheating, including plagiarism is a scholastic offense. 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. Scholastic offences are taken seriously and students are directed to the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

SSD: 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 661-2111 x 82147 for any specific question regarding an accommodation.

NOTE: The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (i.e., < 50%) 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 for grading by the student in subsequent years.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

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.

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 relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
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/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/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 midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). 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, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).

4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/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 report your absence using the [Academic Consideration Request Form](#) and 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.
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, 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 "[Application for a Special Exam](#)" form. 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 submit the [Academic Consideration Request Form](#) and 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 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.
 - i) 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.
 - 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, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory 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 are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

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). **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 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

<http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=>

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

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 15, 2023
Full courses and full-year half course (i.e., “E”, “Y” or no suffix)	September 15, 2023
Second term half course (i.e., “B” or “G”)	January 16, 2024

Drop Deadlines:

First term half course without penalty (i.e., “A” or “F”)	November 13, 2023
Full courses and full-year half courses without penalty (i.e., “E”, “Y” or no suffix)	November 30, 2023
Second term half or second term full course without penalty (i.e., “B” or “G”)	March 7, 2024

Contact Information:**Undergraduate Services Office:**

SEB 2097 Phone: 519-661-2130 E-mail: engugrad@uwo.ca

Chemical & Green Process Engineering:

TEB 477 Phone: 519-661-2131 E-mail: cbeugrad@uwo.ca

Civil Engineering:

SEB 3005 Phone: 519-661-2139 E-mail: civil@uwo.ca

Computer, Electrical, Mechatronic Systems & Software Engineering:

TEB 279 Phone: 519-661-3758 E-mail: eceugrad@uwo.ca

Integrated Engineering:

ACEB 2410 Phone: 519-661-6725 E-mail: engceli@uwo.ca

Mechanical Engineering:

SEB 3002 Phone: 519-661-4122 E-mail: mmeundergraduate@uwo.ca

December 7, 2023