Western Engineering

CHEMICAL & BIOCHEMICAL ENGINEERING

CBE 4421A – Introduction to Biomaterials Engineering

Course Outline Fall 2025

Name of the Professor: Amin Rizkalla

TA Name: Hossein Pouri

LECTURE:	Mondays / 12:30-2:30 Tuesdays / 12:30-1:30
TUTORIAL:	Thursdays / 9:30-10:30 am
OFFICE HOURS *if applicable	Fridays /1:00-3:00 pm
ANTIREQUISITE(s):	None
PREREQUISITE(s):	ES 1021A/B
CEAB Academic Units:	Engineering Science 65%, Engineering Design 35%
TEXT / Course Resources / References	Biomaterials: an introduction. Park, Joon, Lakes, R. S., Springer, NY. 2007.
Course Notes	Will be available for download from OWL
DESCRIPTION An introduction of materials science and engineering topics. The four materials classes (metals, ceramics, polymers, composites) will be addressed with emphasis upon the material types and material properties pertinent to their use in implanted medical devices. The structure and properties of biologic tissues and biocompatibility. Specific implant applications will be addressed.	

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	X	Engineering Tools		Impact on Society	
Problem Analysis	X	Individual & Teamwork		Ethics and Equity	
Investigation		Communication		Economics and Project Mgmt.	
Design		Professionalism		Life-Long Learning	

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

- Understand metallic, ceramic, and polymer materials used for surgical and dental implants; biomaterials processing and selection, implant design, physical and mechanical testing; corrosion and wear in the body.
- Understand the aspects of biocompatibility that determine how the body responds to implanted biomaterials and devices.
- Understand the physical and mechanical properties of tissue as related to microstructure.
- Understand some applications of biomaterials.

Note: The four above learning objectives align with and are selected for the assessment of the above graduate attributes.

Learning Outcomes	(CAEB) Graduate Attribute
Introduction to Biomaterials Engineering At the end of this section, students will be able to: a. Demonstrate competence in specialized engineering knowledge such as implant behavior in body environment and the physicochemical and mechanical concepts that govern implant reliability.	KB4
b. Demonstrate the ability to evaluate the physical, chemical, and mechanical properties of biomaterials and formulate a strategy to design a biomaterial for a specific biomedical application.	PA4

Assessment

The final course mark will be determined as follows:

2 Quizzes and 4 assignments	25%
Project	25%
Final examination	50%

Final examination will be cumulative, closed book and 3.0 h duration. Only non-programmable pocket calculators will be permitted. Smart phones should be turned off

EXTRA COURSE INFORMATION

Specific Learning Objectives

Topics (topics and outline are subject to adjustments and changes)

Biomaterials and Biocompatibility

- Introduction to biomaterials
- Biocompatibility, materials, and host response
- Biocompatibility testing

Structure and Properties of Artificial Biomaterials

- Bonding and crystal structure of metals and ceramics
- Biopolymers and types of polymerization
- Composite materials
- Physical, chemical, and mechanical properties of biomaterials

Degradation of Biomaterials

- Corrosion/Degradation of Metals and ceramics
- Degradation of polymers
- Mechanisms of degradation of biodegradable ceramics and polymers

Structure and Properties of Biological Materials

- Extracellular matrix
- Hard and soft tissues
- Interaction between cells and materials

Biomaterials Design and Characterization
- Metallic Implant Materials
- Ceramic Implant Materials
- Polymeric Implant Materials
- Composite Implant Materials
- Scaffolds for tissue engineering

Application of Biomaterials
- Cardiovascular Medical Devices
- Orthopedic implants
- bone cements and adhesives
- Dental implants
- Opthalmic Applications
- Tissue Engineering (hard tissue)
- Tissue Engineering (soft tissue)

Missed/Late Accommodation Policy

Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
Documentation must be provided as soon as possible.

Exam Accommodation

If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
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.
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 the 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

Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see reverse side for information on documentation).
If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean. are in first year) is not required if assignments will be completed prior to the last day of classes.

This course has 4 assignments, and 2 quizzes counted towards your final grade. Please see instructions listed above. Academic consideration will not be granted for missed quizzes. The midterm exam will be replaced by a group project. Please read the proper instructions listed on OWL.
This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by 2 weeks from the time of posting. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of 0.5% per day will be subtracted from the assessed grade. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
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

Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
Requests for academic consideration must include the following components:

- Self-attestation signed by the student (*This is only accepted for the first/one absence*)
- Medical note
- Indication of the course(s) and assessment(s) affected by the request
- Supporting documentation as relevant

Requests without supporting documentation are limited to one per term per course.
Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.
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.

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.

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 assistant, 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 Contacts

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Civil & Environmental Engineering	SEB 3005	519-661-2139	civil@uwo.ca
Office of the Registrar/Student Central	WSSB 1120	519-661-2100	

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