

SYDE 684 - Materials biocompatibility – Spring 2022

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COURSE OBJECTIVE

To develop knowledge on the role of biology, materials science, engineering, and medicine in the biocompatibility of biomedical devices.

SCHEDULE

Tuesday (in person): 2:00-3:20pm, E5 6004

Thursday (in person): 10:00-11:20am, E5 6004

The course is scheduled for 3hrs/week in two 90 min sessions. All lectures and in-class discussion activities will be **in-person**. Attendance and participation in all in-class sessions are expected for learning and skill development. Each week, a lecture (90 min) will cover a topic related to biomaterials science, engineering, and medicine (see weekly schedule details on the topics to be treated). The second part of class time will center around problem solving and discussion on papers given the previous week. Each week, up to two review papers will be assigned to introduce the lecture topic and up to four research papers will be assigned for discussion. Lecture slides and relevant readings will be posted on LEARN in advance.

COURSE DESCRIPTION

The course covers fundamental topics of biocompatibility of materials in medicine (polymers, ceramics, metals, composites, bioengineered materials). Fundamental principles of materials science (bonding, atomic/molecular structure) as well as interfacial engineering of materials will be reviewed. Materials response to biological systems such as corrosion, degradation, leaching, and fracture will be studied in the context of specific biomedical applications. The host response to materials (immune, inflammatory response and coagulation) will also be treated. Specific examples of material interactions with biological systems such as bone, blood, skin, the eye will be studied. Engineering materials to improve biocompatibility will be discussed extensively during lecture time as well literature discussion and problem-solving sessions.

This course is taught in part using problem-based learning techniques. In class exercises/discussion/problem solving session will be used throughout the term. Students are expected to have completed the assignments and/or requested reading to participate in the discussion and problem-solving exercise. Where possible, research articles will also be selected to reflect the research topics of the students registered in the course.

It is expected that each student will spend around 6 to 8 hours per week, additionally to in-class time, on weekly readings and/or assignments.

EVALUATION/LEARNING ASSESSMENTS

- Assignments (15%): biomedical problem case study.
- Journal paper presentation on biocompatibility (15%)
- In class open book quiz: (15%): Series of short problems related to topics covered in week 1 to 4.
- Class Participation (20%): Discussion and participation (10%); debate (10%)
- Final project: grant application 35%

Late submission for assignment and final project: Each student in SYDE 684 is allocated a total of 4 (four) grace days for the entire term, which allows timed deliverables (assignments or final project) to be submitted on LEARN up to 4 days late without penalty (note that a grace day cannot be used partially, ie even if you submit only 8 hours past the deadline for submission, you will still have use one grace day). Assignments submitted more than 4 days after the due-date will receive a grade of 0. Please let me know if you intend to submit late, so that I am aware.

CONTINGENCY PLAN (in the event in COVID-19 safety policy)

In-class sessions

In the event that in-person classes need to be cancelled due to COVID-19 restrictions, the class will move to remote teaching and will use Zoom live sessions during scheduled course times. Attendance and participation in all live sessions are expected for learning and skill development. The chat function will be active, and discussion and questions will be answered in this platform.

In-class quiz:

If we are unable to hold the quiz in-person, the online quiz will run through LEARN. It will be timed and will made be available for a specific time period outside synchronous class time. There is no substitute or alternate for failing to submit the online quiz.

Accommodation of students due to self-isolation:

If you are unable to attend in class activities, please let me know immediately. If you are unable to attend a critical discussion on papers or the debate, some opportunities of remote participation will be available. If you are unable to give an in-person journal club presentation, remote presentation will be arranged.

If you are facing challenges that are affecting more than one course, please contact your Associate Chair or Director of your program. They will review your case and coordinate a reasonable and fair plan in consultation with appropriate others (for example: instructors, Department Undergraduate Studies Committee, Chair, AccessAbility Services, Engineering Counselling services, Registrar's Office).

In addition, if you test positive for COVID, experience COVID-like illness, or need to self-isolate, you should complete two (2) forms:

- **Self-Declared Verification of Illness Form (VIF) on Quest**
- **Campus Wellness COVID Tracking Form**

LEARN.

Course slides reading materials will be posted on LEARN. Students are allowed and encouraged to download materials for their own personal files but are not authorized to post or share SYDE684 materials on sites other than LEARN and with students not registered in the course. In the event that in-person classes are cancelled, ZOOM will be used for video meetings for the Thursday class. Course deliverables will be available and submitted using LEARN.

Turnitin.com.

Text matching software (Turnitin®) may be used to screen assignments in this course. This would be done to verify that use of all material and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin®. Students will be provided about arrangements and alternatives for the use of Turnitin® in this course.

Note: We are facing unusual and challenging times. The instructor reserves the right to modify course topics and/or assessments with due notice. In the event of further challenges, the instructor will work with the Department to find reasonable and fair solutions.

Writing and Communication Centre.

The Writing and Communication Centre works with students in all Faculties to help you consider your audience, clarify your ideas, develop your voice, and write in the style appropriate to your discipline. They offer one-on-one support for writing papers, delivering presentations, integrating research, and revising for clarity and coherence. Group appointments for team-based projects, presentations, and papers are also available.

All of their services are available virtually: booked appointments, drop-ins, resources, and writing groups. Check out their website for other ways to interact with us, such as open online forums and online “Question and Answers”. Visit at www.uwaterloo.ca/wcc.

Please note that communication specialists guide you to see your work as readers would. They can teach you revising skills and strategies, but will not change or correct your work for you. Please bring your assignment instructions and any notes or drafts to your appointment.

[Link [Writing and Communication Centre](#)]

Scheduling of Synchronous (live) online course events: Due to the COVID-19 pandemic, to accommodate different time zones, different working/studying conditions and limitations in internet access, all critical course components, including lectures and student support must also be made available in asynchronous formats. Any timed component (for example: a test or quiz) must take time zone and internet availability into account.

Course and Departmental Expectations in SYDE

Guiding Principles for our SYDE-BME Community and all students enrolled in SYDE 584:

- 1) Be compassionate (with ourselves and others).
- 2) Be accountable (instructors and students).
- 3) Be patient (with ourselves and others).
- 4) Stay safe and healthy (all of us).

Compassionate and respectful communication

Most online communication between the Department and students will be done through LEARN and/or email. Students are reminded that they should now use their email account name@uwaterloo.ca. Include an academic signature with your full name, program, student ID. We encourage you to include your preferred pronouns (he/him; she/her; they/them).

SYDE-BME comment on accommodation

We respect that our engineering students are independent adult decision-makers, with many opportunities to partake in activities that might be in time conflict with academic deadlines and deliverables. Along with the right to make adult decisions comes the responsibility and accountability for those decisions and any outcomes.

The University of Waterloo's policy on accommodation for missed deliverables pertains to verifiable health matters, and highly unfortunate events (for example: family tragedies). The Department of Systems Design Engineering follows University of Waterloo's general policy: students who self-elect to forgo a deliverable receive a "0" for that deliverable. It is preferred practice so that fairness is maintained for members of the same class/course by avoiding preferential treatment, and so that instructors are not burdened with having to create extra quizzes, deliverables, etc. It also reflects professional practice, as failing to show up to work and missing deadlines can be very costly to the company and individual (for example: not submitting a contract proposal, or design review on time). *Please read the policy here: [Link [Accommodation due to illness/](#)*

SYDE-BME Academic Priorities over Co-op Interviews

With asynchronous schedules, students should be able to arrange co-op interviews that do not conflict with major deliverables (for example: timed course midterms, final exams). For deliverables with longer time windows (for example: 24-48 hours or more), students must manage their time for deliverables and co-op interviews accordingly. If a co-op interview conflicts with a short deliverable time window (for example: 1-3 hours), then students MUST follow the CECA procedure for rescheduling the interview: *[Link [CECA rescheduling co-op interviews](#)]*

Compassionate Accommodation

There are times when the Department will make compassionate accommodation for students experiencing circumstances beyond their control or facing challenges that are affecting more than one course. When warranted, Professor Gorbet will coordinate with your Associate Chair Undergraduate (ACUG) or Program Director a reasonable and fair plan in consultation with appropriate others (e.g. Chair, AccessAbility

Services, Engineering Counselling services, Registrar's Office).

Online Academic Integrity.

All students are expected to work individually and submit their own original work. Under Policy 71, the instructor may have follow-up conversations with individual students to ensure that the work submitted was completed on their own. Any follow up will be conducted remotely (e.g., MS Teams, Skype, phone), as the University of Waterloo has suspended all in-person meetings until further notice.

Wellness Support and Contact Information.

University can be a challenging environment and it is normal to need support from time-to-time. Campus Wellness services are available to students through counselling and health services. If you are struggling or need someone to talk to you, please reach out. To book an appointment or learn more about the services, call 519-888-4567 x 32655 or explore www.uwaterloo.ca/campus-wellness. If you're experiencing a crisis and feel unable to cope and Campus Wellness is closed, contact any of these after-hours supports: EmpowerMe (1-833-628-5589), Good2Talk (1-866-925-5454) or Here 24/7 (1-844-437-3247). They are available at any time of the day or night to help.

Faculty Of Engineering – More Fine Print

Faculty of Engineering website: [[Link Academic Support and Policies](#)].

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect, and responsibility. [Check Academic Integrity website for more information. Link [Office of Academic Integrity](#)].

Discipline: A student is expected to know what constitutes academic integrity (see link above) to avoid committing an academic offence, and to take responsibility for their actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (for example: plagiarism, cheating) or about expectations for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. Relevant documents include:

- University of Waterloo Policy 71 [[Link Policy 71 Student Discipline](#)].
- Academic Penalty Guidelines [[Link Policy 71 Penalty Guidelines](#)].
- Assessment of Unauthorized Collaboration: [[Link Assessment of Unauthorized Collaboration](#)].

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4. When in doubt please be certain to contact the SYDE **Associate Chair for Graduate Studies** who will provide further assistance. [[Link Policy 70 Petitions & Grievance](#).]

Appeals: A decision made, or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who

believes they have a ground for an appeal should refer to Policy 72 (Student Appeals) [Link [Policy 72 Student Appeals](#)].

AccessAbility Services: AccessAbility Services (A.A.S.) is the University's centralized office for the provision of academic accommodations for students with a known or unknown disability, illness, or condition. Even if students are unsure of whether they qualify for A.A.S. support, an A.A.S. consultant can talk them through next steps, and refer them elsewhere if appropriate. [Link [AccessAbility Services](#)]

TOPIC SCHEDULE BY WEEK (schedule is subject to change and/or update)

Week # and dates	Lecture topic Tuesday, 14h00-15h20	In class Discussion and problem solving topic Thursday, 10h00-11h20
1- May 3 May 5	Introduction to the Biological Environment and Biocompatibility	Introduction to the Biological Environment and Biocompatibility
2- May 10 May 12	Introduction to Biomaterials Science: chemical structure and physical properties of biomaterials; synthesis and applications.	How to develop a research proposal
3- May 17 May 19	Biomaterials characterization and interfacial engineering of Materials	Critical discussion of papers related to week 2+Journal club
4- May 24 May 26	Host Response I: Protein adsorption, Inflammatory Response & Blood coagulation	Critical discussion of papers related to week 3+Journal club
5- May 31 Jun 2	In class quiz	Critical discussion of papers related to week 4+Journal club
6- Jun 7 Jun 9	Host Response II: Wound healing	Guest lecture: introduction on microscopy
7- Jun 14 Jun 16	Host Response II: Wound healing	Critical discussion of papers related to week 6+Journal club
8- Jun 21 Jun 23	Host response III: Immune Response & Infection	Critical discussion of papers related to week 7+Journal club
9- Jun 28 Jun 30	Materials Response I: Fatigue and Wear	Critical discussion of papers related to week 8+Journal club
10- Jul 5 Jul 7	Material Response II: Corrosion, Swelling, Leaching, and material degradation	Critical discussion of papers related to week 9+Journal club
11- Jul 12 Jul 14	FDA regulation and the road from idea to market for a medical device OR Novel approaches to biomaterials, medical devices, and biocompatibility models	Critical discussion of papers related to week 10+Journal club
12- Jul 19 Jul 21	Journal club + prep time for Debate (topics to be determined)	Debate/involves group presentation