

Engineering Physics
ENGPYHS 4B03
(Nano)Biosensors – Fundamentals and Applications
Undergraduate Studies
Winter 2027
Course Outline

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
By appointment and/or Mondays and Wednesdays
directly after the class.

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

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Office Hours:
By appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

The official means of communication with students is via the course webpage on [Avenue to Learn](#).
It is the students' responsibility to regularly check the course webpage for updates and announcements.

CLASS FORMAT

The course is organized as follows:

Lectures: Lectures by the instructors about fundamentals and applications of biosensing principles, methods, technologies, and applications. Presentation slides will be made available online but the lectures will not be recorded. Therefore, in-person participation is highly recommended.

Guest Lectures: Several guest lectures by researchers from different biosensing fields at McMaster and outside McMaster. Here, different research technologies and applications will be presented and discussed. If the guest speaker agrees, presentation slides will be made available online but the lectures will not be recorded. Therefore, in-person participation is highly recommended.

Student-led presentations and discussions: Students will form **groups of 3 students** and each group selects one biosensing-related research article from the journal *ACS Sensors*. This selection can be done by the students on their own or with the support of the instructor and/or teaching assistant. **Deadline for research paper selection (and group formation) is January 17th** (see course schedule). The selected article must be confirmed by the instructor.

Stage 1 (pitches – weeks 4 and 5): The selected articles will be presented by each group in a short 4-min oral pitch (only one slide allowed as support) that should be a

concise and convincing argumentation of why the sensing technology or application of the article is important and present the benefits compared to the state-of-the-art. Most of that information is normally found in the abstract and introduction of the articles. The pitch slide must be submitted (via Avenue to Learn) on the day before the pitch presentation. Late submissions will not be accepted and a grade of ZERO will be allocated.

Stage 2 (presentations + discussions – weeks 8 to 12): The selected articles will be presented in detail by each group in a 10-min oral presentation plus 5 min discussion with the audience (10 slides maximum are allowed as support). This presentation should describe the technical details of the sensing technology and thoroughly discuss and critically analyze the obtained results. It should also contain a critical analysis (with pros and cons) with regard to the initial pitch (which was most probably only positive. The presentation will be followed by a 5-min discussion with the entire class. Creative design of the presentation and interaction with the audience are strongly encouraged. The presentation slides must be submitted (via Avenue to Learn) on the day before the pitch presentation. Late submissions will not be accepted and a grade of ZERO will be allocated.

**Presentation + discussion
summary:**

Each student group is required to write a **1 page summary** (summaries longer than 1 page will be graded ZERO) of their presentation and the discussion. The written summaries are due one week after the presentation + discussion day (submission via Avenue to Learn). Late summaries will not be accepted and a grade of ZERO will be allocated.

Project proposal:

Each student group must develop a project proposal based on a paper provided by the instructor. The idea of the proposal is to extend the concept of the provided paper and propose novel and impactful research that has the potential to significantly advance the topic of the provided paper. The research proposal should follow the proposal guidance document and should not be longer than **2 pages** (including figures, schemes, and references). Plagiarism (including self-plagiarism) and AI generation will be checked using available software tools and the results of the check will be applied for grading. The written proposals are due on March 26th (submission via Avenue to Learn). Late proposals will not be accepted and a grade of ZERO will be allocated.

Lecture report:

Each student is required to write a **1 page report** (reports longer than 1 page will be graded ZERO) concerning all instructor and guest lectures. The reports should contain one paragraph of introduction, one paragraph about the instructor lectures, one paragraph about the guest lectures, and one conclusion paragraph. Pros and cons (what did you like and dislike and what could be improved concerning the topics and lectures) should be mentioned. The lecture reports are due on April 10th (submission via Avenue to Learn). Late reports will not be accepted and a grade of ZERO will be allocated.

COURSE INTENDED LEARNING OUTCOMES

By the end of this course, students should be able to:

- Understand the basic theory of different biosensors
- Understand the basics of nanobiotechnology for sensing
- Understand different applications of biosensors
- Interpret, present, and discuss a scientific article about biosensors
- Develop a research project about biosensors

ENGINEERING ACCREDITATION: GRADUATE ATTRIBUTES AND LEARNING OUTCOMES

The Canadian Engineering Accreditation Board (CEAB) is a division of Engineers Canada and is responsible for accrediting undergraduate engineering programs across Canada. Accreditation by the CEAB ensures that the engineering programs meet a national standard of quality and cover essential educational requirements. Graduate Attributes are a set of qualities and skills that the CEAB expects engineering graduates to possess. These attributes are a benchmark for the learning outcomes of accredited engineering programs. This section lists the Graduate Attribute Indicators associated with some of the Learning Outcomes in this course.

The Graduate Attributes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes and Indicators

The students will learn the basic engineering and application aspects of biosensor design and development and the implementation of nanotechnology into different biosensing solutions.

The students will learn to present diverse and multidisciplinary information clearly and concisely as appropriate to the audience and to critically discuss pros and cons of different technological biosensing solutions.

The students will learn to propose creative and innovative solutions to open-needed technological biosensing problems by developing and writing their project proposal.

The students will learn to respond to technical as well as non-technical questions by applying their knowledge gained during the lectures and through implementing their presentation and project proposal.

For more information on Engineering Accreditation, please visit: <https://www.engineerscanada.ca>

COURSE SCHEDULE

The following preliminary schedule will be applied but may be changed as appropriate (depending on the number of student presentations and guest lectures). **Updated versions will be posted on Avenue-to-Learn.**

Week	Day	Time	Date	Content
1	Monday	11:30-12:20	4-Jan-27	Instructor lecture (Introduction to the course)
	Wednesday	11:30-12:20	6-Jan-27	Instructor lecture (Basic principles of biosensing - part I)
	Friday	1:30-2:20	8-Jan-27	Instructor lecture (Basic principles of biosensing - part II)
2	Monday	11:30-12:20	11-Jan-27	Instructor lecture (Nanobiosensors - part I)
	Wednesday	11:30-12:20	13-Jan-27	Instructor lecture (Nanobiosensors - part II)
	Friday	1:30-2:20	15-Jan-27	Instructor lecture (Nanobiosensors - part III) or guest lecture
DEADLINE	Sunday	11:59 PM	17-Jan-27	RESEARCH PAPER SELECTION DEADLINE
3	Monday	11:30-12:20	18-Jan-27	Instructor lecture (Nanobiosensors - part IV) or guest lecture
	Wednesday	11:30-12:20	20-Jan-27	Instructor lecture (Bioimaging) or guest lecture
	Friday	1:30-2:20	21-Jan-27	Instructor lecture (Optrodes) or guest lecture
4	Monday	11:30-12:20	25-Jan-27	4-min student pitches groups 1 to 9
	Wednesday	11:30-12:20	27-Jan-27	4-min student pitches groups 10 to 18
	Friday	1:30-2:20	29-Jan-27	4-min student pitches groups 19 to 27
5	Monday	11:30-12:20	1-Feb-27	4-min student pitches groups 28 to 36
	Wednesday	11:30-12:20	3-Feb-27	Instructor lecture (FRET biosensors - part I) or guest lecture
	Friday	1:30-2:20	5-Feb-27	Instructor lecture (FRET biosensors - part II) or guest lecture
6	Monday	11:30-12:20	8-Feb-27	Instructor lecture (nucleic acid biosensors) or guest lecture
	Wednesday	11:30-12:20	10-Feb-27	Instructor lecture (protein biosensors) or guest lecture
	Friday	1:30-2:20	12-Feb-27	Instructor lecture (environmental biosensors) or guest lecture
7	Monday	11:30-12:20	15-Feb-27	Mid-term recess (no class)
	Wednesday	11:30-12:20	17-Feb-27	Mid-term recess (no class)
	Friday	1:30-2:20	19-Feb-27	Mid-term recess (no class)
8	Monday	11:30-12:20	22-Feb-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Wednesday	11:30-12:20	24-Feb-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Friday	1:30-2:20	26-Feb-27	10+5 min student presentation+discussion (3 groups) or guest lecture
9	Monday	11:30-12:20	1-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Wednesday	11:30-12:20	3-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Friday	1:30-2:20	5-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
10	Monday	11:30-12:20	8-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Wednesday	11:30-12:20	10-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Friday	1:30-2:20	12-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
11	Monday	11:30-12:20	15-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Wednesday	11:30-12:20	17-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Friday	1:30-2:20	19-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
12	Monday	11:30-12:20	22-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Wednesday	11:30-12:20	24-Mar-27	10+5 min student presentation+discussion (3 groups) or guest lecture
	Friday	1:30-2:20	26-Mar-27	Good Friday (no class)
DEADLINE	Sunday	11:59 PM	26-Mar-27	RESEARCH PROPOSAL SUBMISSION DEADLINE
13	Monday	11:30-12:20	29-Mar-27	Instructor lecture or guest lecture
	Wednesday	11:30-12:20	31-Mar-27	Instructor lecture or guest lecture
	Friday	1:30-2:20	2-Apr-27	Instructor lecture or guest lecture
14	Monday	11:30-12:20	5-Apr-27	Instructor lecture or guest lecture
	Wednesday	11:30-12:20	7-Apr-27	Final remarks

This lecture schedule is based upon current university and public health guidelines and may be subject to changes during the term. Any changes to the schedule or course delivery will be communicated on the course announcements section on Avenue to Learn. Please check the announcements prior to attending class.

REQUIRED/OPTIONAL MATERIALS AND FEES

Required Texts: Access to the ACS journal *ACS Sensors* (no costs via McMaster) for the preparation of student presentations and reports

Recommended Additional Texts: NA

Calculator: NA

Other Materials: Access to a computer for assessing course-related material (e.g., lecture notes, presentation slides) and for performing course-related assignments (e.g., preparation of presentations, summaries, and research proposals).

COURSE ASSESSMENT DETAILS

Component	Due Date	Weight
Student-led pitch	Day of the pitch	20 %
Student-led presentation + discussion	Day of the presentation + discussion	40 %
Presentation + discussion summary	One week after presentation + discussion	10 %
Project proposal	March 26 th	20 %
Lecture report	April 10 th	10 %
Total		100 %

ALL WRITTEN ASSESSMENTS MUST BE SUBMITTED ON TIME VIA AVENUE TO LEARN

GRADING SCALE

The McMaster 12 Point Grading Scale

Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. All course materials are due at the date, time, and format announced on Avenue to Learn. Failure to submit your work on time will lead to a grade of ZERO.

GENERATIVE AI

Students may use generative AI for (editing/translating/outlining/brainstorming/revising/etc.) their work throughout the course so long as the use of generative AI is referenced and cited following citation instructions given in the syllabus. Use of generative AI outside the stated use (editing/translating/outlining/brainstorming/revising/etc.) without citation will constitute academic dishonesty. It is the student's responsibility to be clear on the limitations for use and to be clear on the expectations for citation and reference and to do so appropriately. In alignment with [McMaster academic integrity policy](#), it "shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also stated in the policy is the following, "Contract Cheating is the act of "outsourcing of student work to third parties" (Lancaster & Clarke, 2016, p. 639) with or without payment." Using Generative AI tools can be a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

Also see [Guidelines on the Use of Generative AI in Teaching and Learning - Academic Excellence - Office of the Provost](#) for more information. Please note how this intersects with the following guidance on academic dishonesty.

APPROVED ADVISORY STATEMENTS

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Engineering Physics and the Faculty of Engineering are committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the [Equity and Inclusion Office](#).

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online

platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

ACADEMIC ADVISING

Academic Advisors are available to assist you with any problems or questions you may have. This includes course selections, changes to your enrolment, McMaster Student Absence Form (MSAF), Religious, Indigenous, or Spiritual Observances (RISO) forms, exams, taking courses at another university (for credit at McMaster), Petitions for Special Consideration, and much more. Below is the contact information for the Office of the Associate Dean (Academic) in the Faculty of Engineering:

JHE-Hatch
<https://www.eng.mcmaster.ca/programs/academic-advising>
(905) 525-9140 ext. 24646

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PHYSICAL AND MENTAL HEALTH

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#).

REQUESTS FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "[Requests for Relief for Missed Academic Term Work](#)". An abbreviated version is provided below.

The University recognizes that students periodically require relief from academic work due to extenuating circumstances. Students seeking relief for missed academic term work are expected to read the **McMaster Student Absence Form Policy**. The Policy aims to manage these requests by taking into account the needs and obligations of students, instructors and administrators. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in their course. Any concerns regarding the granting of relief should be directed to the Faculty Office.

1. Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three (3) calendar days:

- Use the [McMaster Student Absence Form](#) (MSAF) on-line self-reporting tool. No further documentation is required.
- Students may submit requests for relief using the MSAF once per term.
- An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
- The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
- The MSAF cannot be used for academic work that has already been completed or attempted.
- An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
- The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. For medical or personal situations lasting more than three (3) calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:
 - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
 - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.