University of Manitoba | Price Faculty of Engineering
Department of Biosystems Engineering

Course Outline

BIOE 3270 Instrumentation and Measurement for Biosystems

Winter 2026

Instructor

- Dr. Jiating Li (she/her)
  E1-342 EITC
  (204) 474-8429
  Jiating.Li@umanitoba.ca

Student Hours

- Wed 3:00 – 4:00 PM (by appointment)

Lab Instructors

- Ms. Minami Maeda
  A-212 AEB
  (204) 474-7247
  Minami.Maeda@umanitoba.ca
- Mr. Daniel Benedet
  A-216 AEB
  (204) 474-8367
  Daniel. Benedet@umanitoba.ca

Teaching Assistant

- Hamideh Faridi
  faridis@myumanitoba.ca

Location

- **Lecture: EITC E2 - 399**
  Tues 10:00 -11:15 AM
  Thurs 10:00 -11:15 AM
- **Labs**: **A-205 AEB**
  Tues 11:30 AM-2:15 PM (B01)
  Tues 2:30 PM-5:15 PM (B02)

Contact Hours

- 4 credit hours
- Lectures: 3 hours x 13 weeks = 39 hours
- Laboratories: 3 hours x 10 weeks = 30 hours

Prerequisites:

- MATH 2132, ENG 1450

Course Website:
http://umanitoba.ca/umlearn

Course Objectives

This course provides students with an understanding of the principles involving basic instrumentation for measuring physical and electrical quantities associated with biological engineering and industry. Examples of the use of these quantities in engineering calculations are provided. As an engineer, you would soon be working on measurement of one or more physical quantities such as temperature, pressure, stress, etc. This course aims to develop the student's skills in basic measurement techniques by teaching the principles behind these techniques and instrumentation involved. The laboratory exercises reinforce this knowledge by teaching hands-on skills.

Course Content

LECTURES: Two and a half hours per week for one term (13 weeks). This is a tentative schedule.

(Jan. 6, 8)	Introduction
(Jan. 13, 15)	Basic circuits
(Jan. 20, 22)	Wheatstone bridge, delta-y transformation
(Jan. 27, 29)	Filters, Operational amplifiers
(Feb. 3, 5)	Operational amplifiers
(Feb. 10, 12)	Instrumentation terms, Temperature measurement
(Feb. 17, 19)	**No classes (Reading Week)**
(Feb. 24, 26)	Temperature measurement
(Mar. 3, 5)	Strain measurements
(Mar. 10, 12)	Strain measurements, **Mid-term exam (March 12)**
(Mar. 17, 19)	Smart sensors and Internet of Things
(Mar. 24, 26)	Pressure measurement
(Mar. 31, Apr. 2)	Humidity measurement
(Apr. 7, 9)	Flow measurement

March 12, 2026: Midterm Examination (during lecture time)
January 19, March 19, 2026: Voluntary Withdrawal Deadline
April 9, 2026: Last day of classes for Winter Term

LABORATORIES:
Laboratory work will require students to conduct experiments in team of 2-3 students and prepare individually written reports outlining the results.

(Jan. 6)	**NO LAB**
(Jan. 13) Lab 1	Introduction to circuitry/measurement
(Jan. 20) Lab 2	Wheatstone bridge
(Jan. 27) Lab 3	Pressure measurement
(Feb. 3) Lab 4	Operational amplifiers 1
(Feb. 10)	**NO LAB**
(Feb. 17)	**NO LAB (Reading Week)**
(Feb. 24) Lab 5	Operational amplifiers 2
(Mar. 3) Lab 6	Thermocouples
(Mar. 10) Lab 7	Strain gauge
(Mar. 17) Lab 8	IoT Lab 1
(Mar. 24) Lab 9	IoT Lab 2
(Mar. 31)	TBD

(Apr. 7) **NO LAB**

*Students will be notified in advance if any changes to the lab order or date.

Traditional Territories Acknowledgement

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

Updated: July 11, 2022

Textbook

Suggested textbook: R.S. Figliola and D.E. Beasley. Theory and Design for Mechanical Measurements, 6th ed. Wiley.
Lecture materials: A set of class presentations in pdf format will be available on UM Learn.
Instructional materials for labs will be posted on UM Learn.
Assignments will be posted on UM Learn.

Expectations: You Can Expect Us To

Learning is most effective when both the teacher and the student are engaged in the subject material. The role of the teacher, therefore, is to create an environment that facilitates student engagement and learning. Lectures will be mainly delivered using a tablet computer supported by PowerPoint or One Note or Word presentations. Students will have access to a PDF format of the lecture material at the end of each lecture week. Also, some numerical problems will be solved during lectures. Laboratory work will be conducted individually or in a group. Instructional materials for each laboratory exercise will be provided on UM Learn a day before the lab. Assignments will be posted on UM Learn. Lab reports and assignments will be marked by a Teaching Assistant who will be available for consultations or additional clarifications of the evaluation of assignments and lab reports. At the beginning of the course students will be formally informed about nature of on-line/in-person exams, structure of the lab reports, project, assignments, submission rules, and most importantly the deadline. The instructor will be available for individual student consultation by appointment.

Expectations: We Expect You To

It is expected that you be in attendance, and on time, for all scheduled lectures. If you must be absent, please be courteous and send an e-mail notifying the instructor of your absence. Laboratory work will require students to observe/conduct experiments and to present written reports outlining the results. All labs need to be attended. Each student is obligated to perform their own tests and write a report based on their own data. No “borrowing” data is expected in this course. All e-mail communication needs to be done through the students’ university e-mail addresses. To benefit the most from this class, you will be expected to prepare for class by reading the assigned materials.

Assignment Extension and Late Submission Policy

Deadlines are a reality in the world of engineering; we expect assignments to be completed on time. All assignments need to be submitted via UM Learn before the deadline. Late submissions will not be accepted; any assignment missed for an appropriate, documented reason will be submitted with instructor’s approval. If you miss the mid-term exam for a legitimate reason, the marks for it will be rolled over to the final (there will be no ‘make-up’ midterm).

Lab Sessions Attendance and Reports

The laboratory component of the course is very important. Student should attend and submit the lab reports at least (70%) in order to pass the course. Late submission of lab reports would result in loss of 20% marks for each working day. No labs reports will be accepted after the end date (5 days after the deadline). Students registered with accessibility service should contact the instructor in advance and specify the need for required time. No extension for lab reports and assignments deadlines. All enquiries regarding the lab reports grading should be addressed to the course instructor and TA.

E-mailing rule

Students must use their UM-assigned e-mail account for all course-related communication and include the subject line “BIOE 3270 - Enquiry”. The instructor will respond to emails within 48 hours on weekdays. Emails sent on weekends should not be expected to receive a response until the following week.

Accreditation Details

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 100%
- Engineering Design: 0%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

I - Introduced
D – Intermediate (Developing)
A - Advanced

Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Letter	Mark
A+	92 – 100
A	85 – 91
B+	78 – 84
B	72 – 77
C+	66 – 71
C	60 – 65
D	50 – 59
F	< 50

Referencing Style

Students are expected to follow the Canadian Biosystems Engineering (CBE) journal reference style when citing references in course assignments. The Instructions for preparing a paper for CBE is available through UM Learn. Please refer to this guide to ensure that you follow the correct referencing style.

Learning Outcomes

By the end of this course, you will be able to:

No.	Learning Outcome
1	Define the theory and principles involved in measurement of physical quantities such as electricity, temperature, stress/strain, pressure, humidity, and flow.
2	Understand definitions related to measurement of physical/electrical quantities such as precision, accuracy, repeatability, etc.
3	Be able to measure and determine basic electrical quantities (such as voltage, current, power, etc.) and physical quantities (such as temperature, stress/strain, pressure, humidity, and flow).
4	Obtain hands-on skills of using common instrumentation and sensor (such as oscilloscope, IoTs), as well as knowing their applications in biosystems.
5	Understand the concept of designing an experiment and deal with the errors associated with measurements of attributes.
6	Collaborate equitably with group members (if needed) in a team setting to manage lab exercises. Take down experimental readings, analyze, present, interpret, and communicate experimental results obtained during laboratory exercises.

CEAB Graduate Attributes Assessed

This course will assess the following CEAB graduate attribute indicators shown below:

Indicator (Level)	Indicator Description	Assessment Point
KB.3 (A)	Recalls, defines, comprehends and applies information and concepts in fundamental engineering science.	Assignments, mid and final exam
PA.3 (D)	Analyzes and solves complex engineering problems.	Final exam
IN.1 (D)	Gathers information (literature review, measurements, experiments, laboratory exercises) and analyzes data.	Assignments, lab reports, final exam
IN.3 (D)	Interprets results and reaches appropriate conclusions.	Lab report, final exam
CS.1 (D)	Designs and produces effective written and graphical engineering documents for specific audiences (e.g., research reports, engineering reports, design documents).	Lab report, final exam

Important Dates

- **Early Withdrawal Deadline**
  January 19, 2026
- **Louis Riel Day**
  February 16, 2026
  No classes or examinations
- **Winter Term Break**
  February 16-20, 2026
  No classes or examinations
- **Voluntary Withdrawal Deadline**
  March 19, 2026
- **Last Day of Classes**
  April 9, 2026
- **Examination Dates**
  April 11 - 25, 2026

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Class engagement & attendance	5	JL	S	1,2	I
Midterm Exam	20	JL	S	1,2,4	I
Assignments	20	HF & JL	F, S	1,2,3,4	I
Lab attendance & reports	20	HF & JL	F, S	3,4,6	I/T
Final Exam	35	JL		1,2,3,4,5,6	I

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

** I/T: **I** – Individual effort, **T** – Team effort

HF - Hamideh Faridi, JL – Jiating Li

Academic Integrity and Generative Artificial Intelligence (genAI)

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

The use of generative artificial intelligence (genAI) tools and apps is strictly prohibited in all course assignments unless explicitly stated otherwise by the instructor in this course. This includes ChatGPT and other AI writing and coding assistants. Use of genAI in this course may be considered use of an unauthorized aid, which is a form of cheating.

Requirements/Regulations

No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.

All email communication must conform to the Communicating with Students university policy.

Communicating with Students

Attending lectures and laboratories is essential for the successful completion of this course.

Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don't need to share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

Self-Declaration Form for Brief or Temporary Absence

This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

Self-Declaration Policy for Brief or Temporary Absences

It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance, and withdrawal.

General Academic Regulations *Engineering Academic Regulations*

Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Deferred Final Examinations

Students who miss the regularly scheduled writing of a final examination for valid medical or compassionate reasons will only be allowed to write a deferred exam if the Associate Dean (Undergraduate) approves the request. All requests for a deferred examination must be made within 48 hours of the missed exam and follow the procedure described on the Faculty website without exception. Course Instructors do not have the discretion to grant deferred final examinations. Deferred Exam Policy (student experience website) https://umanitoba.ca/engineering/student-experience

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