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

Course Outline

Instruction
- Dr. Chyngyz Erkinbaev (he/him)
  E1-344 EITC
  (204) 474-6977
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Student Hours
- Wed 2:00 – 3:00 PM (by appointment)

Lab Instructors:
- Mr. Matt McDonald
  A-216 AEB
  (204) 474-8367
  Matt.McDonald@umanitoba.ca
- Ms. Minami Maeda
  A-212 AEB
  (204) 474-8367
  Minami.Maeda@umanitoba.ca
- Mr. Daniel Benedet
  A-216 AEB
  (204) 474-8367
  Daniel. Benedet@umanitoba.ca

Teaching Assistant
- TBD

Location
- **E2-304**
  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:
  2.5 hours x 12 weeks = 36 hours
- Laboratories:
  3 hours x 12 weeks = 36 hours

Prerequisites:
- MATH 2132, ENG 1450

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

BIOE 3270 Instrumentation and Measurement for Biosystems

Winter 2023

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)

Week (Jan. 9)	Introduction
Week (Jan. 16)	Basic circuits
Week (Jan. 23)	Wheatstone bridge, delta-y transformation
Week (Jan. 30)	Filters, Operational amplifiers
Week (Feb. 6)	Operational amplifiers
Week (Feb. 13)	Instrumentation terms
Week (Feb. 20)	**Reading Week**
Week (Feb. 27)	Error analysis, Order of instruments
Week (Mar. 6)	Temperature measurement
Week (Mar. 13)	Thermocouples **Mid-term exam (March 14, 2023)**
Week (Mar. 20)	Strain measurements
Week (Mar. 27)	Pressure measurement
Week (Apr. 3)	Humidity measurement, Flow measurement
Week (Apr. 10)	Smart sensors and Internet of Things, Imaging

March 14, 2023: Midterm Examination (during lecture class)
February 4, 2023, April 25, 2023: Voluntary Withdrawal Deadline
April 12, 2023: 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.

Lab 1 (Jan. 17)	Introduction to circuitry/measurement
Lab 2 (Jan. 24)	Wheatstone bridge
Lab 3 (Jan. 31)	Pressure measurement
Lab 4 (Feb. 7)	Operational amplifiers 1
NO LAB (Feb. 14)	
NO LAB (Feb. 22)	**Reading Week**
Lab 5 (Feb. 28)	Operational amplifiers 2
Lab 6 (Mar. 7)	Thermocouples 1
Lab 7 (Mar. 14)	Strain gauge
Lab 8 (Mar. 21)	IoT Lab 1
Lab 9 (Mar. 28)	IoT Lab 2
Lab 10 (Apr. 4)	Imaging
NO LAB (Apr. 11)	

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

Textbook:

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

Use UM assigned e-mail ONLY with subject line "BIOE 3270, name, enquiry subject.

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.

Accreditation Details

- Mathematics: 20%
- Natural Science: 30%
- Complementary Studies: 0%
- Engineering Science: 25%
- Engineering Design: 25%

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

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

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	85–92
B+	85–78
B	78–72
C+	72–66
C	66–60
D	60-50
F	< 50

Learning Outcomes

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

No.	Learning Outcome	Transferable Skill
1	Understand the theory and principles involved in measurement of physical quantities such as electricity, temperature, stress/strain, pressure, humidity, and flow.	A knowledge base for engineering
2	Understand definitions related to measurement of physical/electrical quantities such as precision, accuracy, repeatability, etc.	A knowledge base for engineering
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).	Teamwork; design
4	Understand the basics of image acquisition, processing and applications in biosystems.	Design, project management
5	Understand the concept of designing an experiment and deal with the errors associated with measurements of attributes.	Problem analysis
6	Collaborate equitably with group members (if needed) in a team setting to manage lab exercises. Take down experimental readings, analyze, present, and communicate experimental results obtained during laboratory exercises.	Communication skills

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	4											
2	4											
3				3		3						
4				3		4						
5		4										
6							4					

CEAB Graduate Attributes Assessed

KB.4 – Determined the engineering problems associated with measurements and instrumentation.

DE.3 – Develops possible solutions to an open-ended design problem, leading to an appropriate recommendation.

IT.3 – Participates in group activities, lab sessions, and decision-making.

PA.4 – Provide solution for conceptual design of measuring systems.

CS. 4 – Demonstrate communication and writing skills.

Important Dates

- **Early Withdrawal Deadline**
  January 20, 2023
- **Louis Riel Day**
  February 20, 2023
  No classes or examinations
- **Winter Term Break**
  February 21 -24, 2023
  No classes or examinations
- **Good Friday**
  April 7, 2023
  No classes or examinations
- **Voluntary Withdrawal Deadline**
  March 22, 2023
- **Last Day of Classes**
  April 12, 2023
- **Examination Dates**
  April 14 - 28, 2023

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Midterm Exam	25	CE	S	1,2, 4	I
Assignments	10	CE	F, S	1,2,3,4	I
Lab reports	20	CE	F, S	3,4	I/T
Quizzes	5	CE	S	1,2,3	T
Final Exam	40	CE		1,2,3,4,5,6	

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

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

Academic Integrity

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.

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.

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