



University of Manitoba
Faculty of Agricultural & Food Sciences
Department of Biosystems Engineering

Course Details

Course Title & Number:	BIOE 3270 INSTRUMENTATION AND MEASUREMENT FOR BIOSYSTEMS
Number of Credit Hours:	4
Class Times & Days of Week:	Lectures: TR 10:00-11:15 am Labs: T, 11:30 AM
Location for classes/labs:	On-line UM Learn/Cisco WebEx Labs: On-line UM Learn/Cisco WebEx
Pre-Requisites:	<u>MATH 2132</u> ; <u>ENG 1450</u>

Course Description:

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.

Instructor Information

Instructor(s) Name:	Dr. Chyngyz Erkinbaev, Assistant Professor I prefer to be addressed as Dr. Erkinbaev
Office Location:	E1-344 Engineering & Information Technology Complex (EITC)
Office Hours or Availability:	Please make an appointment if you wish to meet with me outside of class hours via E-mail.
Office Phone No.	204-474-6977 (Erkinbaev)
Email:	chyngyz.erkinbaev@umanitoba.ca
Contact:	You may contact me by email. Emails sent after business hours will not likely be answered until the next day.

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Teaching Assistant: Mr. Jean-Christophe Habeck
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General Course Information

Why is this course useful?

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. This course will help you learn these fundamental engineering skills.

How does this course fit into the curriculum?

This is an engineering core course in the Biosystems Engineering program. It is intended that students take this course during the third year of the program. As mentioned above, this course introduces the student to several fundamental engineering skills that are very important when conducting experimental work. The skills obtained in this course will come in handy when doing the undergraduate thesis and doing on-site measurements in the industry (upon graduation or during co-op).

Course Goals

The intent of this course is to:

- introduce students to the basic theory and instrumentation involved in measurement of physical quantities
- provide students with an opportunity to use lab instruments to measure some of the physical quantities
- provide students with an opportunity to collaborate equitably with group members in a team setting to acquire hands-on skills of using lab instrumentation
- provide students with opportunities to effectively communicate experimental procedures, data and results

Intended Learning Outcomes

At the conclusion of the course, the student should be able to:

- 1 Understand 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 Understand the concept of designing an experiment and deal with the errors associated with measurements of attributes.
 - 5 Collaborate equitably with group members (if needed) in a team setting to manage lab exercises
 - 6 Take down experimental readings, analyze, present, and communicate experimental results obtained during laboratory exercises.
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Textbook, Readings, Materials

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

Using Copyrighted Material

Please respect copyright. We will use copyrighted content in this course. The content used is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by us, are made available for private study and research and must not be distributed in any format without permission.

Recording Class Lectures

Dr. Chyngyz Erkinbaev and the University of Manitoba hold copyright over the course materials, presentations and lectures that form part of this course. **No audio or video recording of lectures or presentations, and laboratory session is allowed** in any format, openly or surreptitiously, in whole or in part without permission from Dr. Erkinbaev. Course materials (both paper and digital) are for the participant's private study and research.

Course Technology

In Winter 2021 term, the entire course (lectures and labs) will be delivered on-line. Students will need to use desktop computer, laptop, tablet, or phone for accessing the UM Learn/Cisco WebEx. Some course materials will be available through UM Learn.

Class Communication

The University requires all students to activate an official University email account. For full details of the Electronic Communication with Students please visit:

http://umanitoba.ca/admin/governance/media/Electronic_Communication_with_Students_Policy_-_2014_06_05.pdf

Please note that all communication between you as a student and your instructors/TAs must comply with the electronic communication with student policy

(http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html). You are required to obtain and use your U of M email account for all communication between yourself and the university.

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 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 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 on-line 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.

Academic Integrity:

Plagiarism or any other form of cheating in examinations, term tests or academic work is subject to serious academic penalty. Cheating in examinations or tests may take the form of copying from another student or bringing unauthorized materials into the exam room. Exam cheating can also include exam impersonation. A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty. Students should acquaint themselves with the University’s policy on plagiarism, cheating, exam impersonation and duplicate submission. Electronic detection tools may be used to screen assignments in cases of suspected plagiarism.

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.

Students Accessibility Services (SAS)

Student Accessibility Services

If you are a student who has any special requirements, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

Student Accessibility Services <http://umanitoba.ca/student/saa/accessibility/>

520 University Centre

204 474 7423

Student_accessibility@umanitoba.ca

Class & Lab Schedule

LECTURES: Two and a half hours per week for one term (13 weeks)

Week (Jan. 18) Introduction

Week (Jan. 25) Basic circuits

Week (Feb. 1) Circuits

Week (Feb. 8) Filters, Operational amplifiers

Week (Feb. 15) **Reading Week**

Week (Feb. 22) Operational amplifiers, Instrumentation terms
 Week (Mar. 1) Error analysis, Order of instruments
 Week (Mar. 8) Temperature measurement,
 Week (Mar. 15) Temperature measurement **Mid-term exam (March 16, 2021)**
 Week (Mar. 22) Strain measurements
 Week (Mar. 29) Pressure measurement
 Week (Apr. 5) Humidity measurement, Flow measurement
 Week (Apr. 12) Smart sensors and Internet of Things

March 16, 2021: Midterm Examination (during lecture class)

March 31, 2021: Voluntary Withdrawal Deadline

April 16, 2021: Last day of classes for Winter Term

LABORATORIES: online UM Learn Cisco WebEx

One three-hour period per week. Labs will be conducted on Tuesdays for BO1 at 11:30 am – 2:20 pm and for BO2 at 2:30 pm – 5:30 pm (If there is no time conflicts with another courses, Lab will be conducted as one session for the entire class at 11:30 AM). Laboratory work will require students to conduct experiments and prepare written reports outlining the results.

Lab. 1	(Jan. 26)	Introduction to circuitry/measurement
Lab. 2	(Feb. 2)	Wheatstone bridge
Lab. 3	(Feb. 9)	Pressure measurement
Reading Week	(Feb. 16)	
NO LAB	(Feb. 23)	
Lab. 4	(Mar. 2)	Operational amplifiers 1
Lab. 5	(Mar. 9)	Operational amplifiers 2
Lab. 6	(Mar. 16)	Thermocouples 1
Lab. 7	(Mar. 23)	Strain gauge
Lab. 8	(Mar. 30)	IoT Lab 1
Lab. 9	(Apr. 6)	IoT Lab 2
NO LAB	(Apr. 13)	

Course Evaluation Methods

Final letter grades will be assigned on the basis of the overall performance of the class, and the spread of the numerical marks.

Assignments	10%
Lab Reports	20%
Quiz/Project	5%
Mid-term Exam	25%
Final Exam	40%

There will be 3-4 assignments handed out through the term. The assignment problems deal with circuit design and numerical calculations associated with the measurement of different physical quantities. Other numerical examples will be done in the class during the lectures.

The exams (mid-term and final) will deal with problems (theoretical and numerical) that would be discussed throughout the term in lectures and assignments.

Grading

The grading scale used for this course is shown below.

Letter Grade	Percentage out of 100
A+	92-100
A	85-91
B+	78-84
B	72-77
C+	66-71
C	60-65
D	50-59
F	Less than 50

Assignment Grading Times

The last date for Voluntary Withdrawal (VW) from the course is March 31, 2021. Students can expect to receive grades for several of the assignments and the lab reports, and the midterm prior to the VW date. The evaluation feedback (Mid-term Examination) will be given to the students prior to the VW deadline. Grades for the remaining course assignments and lab reports will be available prior to the end of the term.

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 during class. Late submissions will not be accepted; any assignment missed for an appropriate, documented reason will have the final exam mark instead. 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**).

Supplemental Course Information for BIOE 3270

All courses in the Biosystems Engineering program are expected to contribute, in some way, to the development of one or more of the 12 graduate attributes that have been identified by the Canadian Engineering Accreditation Board. The 12 graduate attributes have been defined below for your information.

Graduate Attributes

1. **A Knowledge Base for Engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **Problem Analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **Use of Engineering Tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and Team Work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **Impact of Engineering on Society and the Environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **Ethics and Equity:** An ability to apply professional ethics, accountability, and equity.
11. **Economics and Project Management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **Life-long Learning:** An ability to identify and address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

While there are likely some aspects of many of these attributes that can be found in this course, the attributes being emphasized in this course are: 1) *A Knowledge Base for Engineering*, 2) *Problem Analysis*, 5) *Use of Engineering Tools*, 6) *Individual and Teamwork* and 8) *Professionalism*.

Mapping of Course Evaluation to Graduate Attributes & Indicators

To maintain the accreditation of our Biosystems Engineering program, it is a requirement that student competency with respect to the 12 graduate attributes be assessed. To enable such assessment to occur in a meaningful manner, the Faculty of Engineering and representatives from industry developed a comprehensive list of indicators for each of the 12 graduate attributes. The indicators being formally assessed in BIOE 3270 are shown in the table below.

Grade Component	Specific Evaluation Point	Graduate Attribute	Indicators Being Assessed
Knowledge base for Engineering	Assignments	Demonstrates competence in engineering fundamentals and measurement of electrical and physical quantities	Various indicators related to the ability to understand and apply theory in engineering problems.
	Lab Reports	Comprehends and applies information in engineering problems	Various indicators related to the ability to carry out measurements, understand errors associated with these measurements, present and interpret results and see limitations
	Midterm Examination	Demonstrates competence in specialized engineering problems	Various indicators related to the ability to understand and apply theory in engineering problems.
	Final Examination	Comprehends and applies information and in specialized engineering problems	Various indicators related to the ability to understand and apply theory to engineering problems.
Problem Analysis	Assignments	Identify problem, select and implement solutions	Various indicators related to the ability to interpret results, identify limitations and implications.
	Mid-term and final examination	Contextualize problems, formulate strategies and implement solutions	Various indicators related to the ability to identify multiple strategies to solve a problem, demonstrate skilful ability to analyze, evaluate and select optimal/practical solution.
Use of Engineering Tools	Lab Reports	Evaluate and select tools to complete engineering activities	Two indicators are used: ability to explain principles behind applicability of engineering tools. Ability to understand the limitations of tools and the ability to discuss the assumptions.
	Final Exam	Evaluate tools to complete engineering activities	Ability to understand the limitations in the use of tools and the ability to discuss the assumptions
Individual and Team work	Assignments	Evaluate individual work contribution and time management	Ability to carry out individual responsibilities, manage time and complete jobs carefully, meticulously and punctually.

	Lab work and Lab Reports	Individual contribution to teamwork, working with others, promoting positive team atmosphere	Ability to work in team and share responsibility
Professionalism	Lab Work, Lab Reports and Assignments	Exhibit behaviour expected from a professional engineer	Demonstrates neat and detailed work, ability to adhere to deadlines and punctuality

The ultimate goal of mapping the course evaluation in specific courses to graduate attributes and indicators is the identification of potential deficiencies in the Biosystems Engineering program so that continuous improvement can occur. Data generated from this course will be compiled with data collected from other sources (i.e., other courses, SEEQ surveys, exit surveys, co-op surveys) to facilitate on-going review and improvement of the Biosystems Engineering curriculum.
