

IBEHS 4F04
Biomedical Instrumentation & Measurements

Fall 2021/22 T1

Course Outline (subject to change at the beginning of September)

CALENDAR/COURSE DESCRIPTION

An introduction of engineering principals applied to the design of biomedical instrumentation including: electrodes, mechanical, chemical and other transducers; signal processing and data acquisition; safety; neuromuscular; cardiovascular, biochemical, biomechanical and other clinical instrumentation.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): IBEHS 3A03, or registration in the Integrated Biomedical Engineering and Health Sciences (IBEHS)
Cross-List(s): ELECENG 4BD4

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Qiyin Fang
ETB 405, qiyin.fang@mcmaster.ca

Office Hours:
by appointment only

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Guha Ganesh ETB 303, ganesg1@mcmaster.ca	Ian Phillips ETB 303, philliih@mcmaster.ca	Tianqi Hong ETB 303, hongt6@mcmaster.ca
M. Ali ETB 303, alik22@mcmaster.ca	Matin Villegas ETB 303, villegm@mcmaster.ca	

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

<http://avenue.mcmaster.ca/> & IBEHS 4F04 Microsoft Teams

COURSE OBJECTIVES

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

LO.1	Analyze a measurement or instrumentation problem and propose a solution.
LO.2	Apply the principles of electronic circuits and devices to design instrumentation.
LO.3	Have knowledge of the principles and use of a variety of electrical and other transducers, analog and digital instrumentation, applied computer signal acquisition and processing.
LO.4	Apply current safety standards in design.
LO.5	Understand the principles and efficacy of instrumentation used in cardiopulmonary, neurological, surgical, analytical and rehabilitation areas of medicine.

MATERIALS AND FEES

Required Texts:

Medical Instrumentation: Application and Design

John G. Webster, Amit J. Nimunkar,

Wiley, 5th Edition, ISBN: 978-1-119-45733-6 June 2020

<https://www.wiley.com/en-ca/Medical+Instrumentation%3A+Application+and+Design%2C+5th+Edition-p-9781119457336>

Optional Texts:

Principles of Biomedical Instrumentation

Andrew G. Webb

Cambridge, 2018 ISBN: 9781107113138

<https://doi.org/10.1017/97811316286210>

Calculator:

Only the McMaster Standard Calculator (available at the Campus Store). will be permitted in tests and examinations.

Other Materials:

TBD

COURSE OVERVIEW

Module	Topic	Readings
1	General Overview of Instrumentation (Filters, Amplifiers, etc.)	Textbook & lecture notes
2	Electrophysiology Instrumentation and Measurement (ECG, EEG, etc.)	
3	Electrical Safety and Standards in Practice	
4	Sensors and Instrumentation to Measure other Variables	
5	Measurement of Cardiopulmonary Function with Instrumentation	
6	Applications of Instrumentation in Biotechnology	

ASSESSMENT

Component	Weight
Assignments (4 assignments @ 5% each)	20%
Labs (5 labs @ 6% each)	30%
Mid-term	20%
Exam	30%
Total	100%

LAB OVERVIEW AND OPERATION

- Labs occur on a bi-weekly basis.
- Labs are completed within groups of 3-5
- Labs have pre-lab work which is to be completed by the group prior to the lab.
- The pre-lab is weighted as 1/3 the total score for labs in which it applies
- **The labs may be completed via a hybrid approach with some members on-site (in person) and some members working remotely. Details TBA**

Lab	Topic
1	Differential Amplifiers & Filters
2	ECG and Heart Rate Measurement
3	EEG Measurement and Analysis
4	EMG and Motor Control
5	Estimation of Position, EOG and Accelerometry

ADDITIONAL DETAILS REGARDING COURSE MANAGEMENT AND ASSESSMENT

- Attendance requirements: Required
- Grade adjustment techniques: N/A
- Group work expectations and how group work will be evaluated: Single grade for the entire group, members are expected to contribute equally.
- Members of a lab group will generally receive the same grade with some exceptions.
- How work is to be submitted: through Avenue to Learn

ACCREDITATION LEARNING OUTCOMES

Disclaimer: The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be taken into consideration in determining a student's actual grade in the course.

Outcomes	Indicators
1. Knowledge	1.4 - LO.3
3. Investigation	3.1 - LO.5
3. Investigation	3.3 - LO.1, LO.2, LO.3, LO.5
8. Professionalism	8.1 - LO.4, LO.5
4. Design	4.2 - LO.4, LO.5
4. Design	4.6 - LO.4, LO.5

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.

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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <http://www.mcmaster.ca/academicintegrity>

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 assignments, tests, and examinations.

ACADEMIC ACCOMMODATIONS

Students who require academic accommodation must contact Student accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contact by phone at 905.525.9140 ext. 28652 or e-mail at sas@mcmaster.ca. For further information, consult McMaster University's Policy for [Academic Accommodation of Students with Disabilities](#).

NOTIFICATION OF STUDENT ABSENCE AND SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

1. The [McMaster Student Absence Form](#) is a self-reporting tool for Undergraduate Students to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note this tool cannot be used during any final examination period.
2. You may submit a maximum of 1 Academic Work Missed request per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation. Relief for missed academic work is not guaranteed.
3. If you are absent for reasons other than medical reasons, for more than 3 days, or exceed 1 request per term you MUST visit the Associate Dean's Office (JHE/A214). You may be required to provide supporting documentation.
4. This form must be submitted during the period of absence or the following day, and is only valid for academic work missed during this period of absence.
5. It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.

6. You should expect to have academic commitments Monday through Saturday but not on Sunday or statutory holidays. If you require an accommodation to meet a religious obligation or to celebrate an important religious holiday, you may submit the Academic Accommodation for Religious, Indigenous and Spiritual Observances (RISO) Form to the Associate Dean's Office. You can find all paperwork needed here: <http://www.eng.mcmaster.ca/current/documents.html>

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

TURNITIN.COM STATEMENT

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/>.

ON-LINE STATEMENT FOR COURSES REQUIRING ONLINE ACCESS OR WORK

In this course, we will be using Avenue-to-Learn (including its e-mail) and Microsoft Teams. Students should be aware that, when they access the electronic components of this course, 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf>.

Integrated Biomedical Engineering & Health Sciences (IBEHS) Labs/Design Studio Safety

Information for Laboratory Safety and Important Contacts

This document is for users of IBEHS instructional laboratories at the following locations:

- ABB C104 (Design Studio)
- ETB 533 (Medical Imaging/Biomaterials Lab)
- ETB 534 (Medical Instrumentation/Robotics Lab)
- HSC 4N72 (Genetic Engineering Lab)

This document provides essential information for the healthy and safe operation of IBEHS instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in IBEHS. It is expected that revisions and updates to this document will be done continually. A McMaster University [lab manual](#) is also available to read in every laboratory.

For Standard Operating Procedures (SOPs), Health and Safety videos and other resources, follow [this link](#).

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

- Food and beverages are not permitted in the instructional laboratories.
- A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
- Laboratory equipment should only be used for its designed purpose.
- Proper and safe use of lab equipment should be known before using it.
- The lab tech or course TA leading the lab should be informed of any unsafe conditions.
- The location and correct use of all available safety equipment should be known.
- Potential hazards and appropriate safety precautions should be determined, and the sufficiency of existing safety equipment should be confirmed before beginning new operations.
- Proper waste disposal procedures should be followed.
- [Personal ergonomics](#) should be practiced when conducting lab work.
- [Current University health and safety](#) issues and protocols should be known.

Location of Safety Equipment

Fire Extinguisher

On walls in halls outside of labs or within labs

Telephone

On the wall of every lab near the door

First Aid Kit

ABB C104, ETB 533, ETB 534, HSC 4N72 or
dial "88" after 4:30 p.m.

Fire Alarm Pulls

Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security:

On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

Hospital Emergency Medical / Security:

For McMaster HSC, call Security at extension **5555** or **905-521-2100** from a cell phone.

Non-Emergency Accident or Incident: Immediately inform the Lab Tech, TA on duty or Course Instructor.

University Security (Enquiries / Non-Emergency):

Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

See Lab Tech, TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs.

Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

IBEHS Specific Instructional Laboratory Concerns: For non-emergency questions specific to the IBEHS laboratories, please contact appropriate personnel below from a McMaster phone:

- Leela Pilli, Laboratory Technician – 26888
- Parmveer Bola, Instructional Assistant – 23521
- Andrej Rusin, Wet Laboratory Technician – 28347
- Alexa Behar-Bannelier, Program Manager – 24548

In Case of a Fire (Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout “*Fire!*” and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt

and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.

6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people.

1. Douse with water from safety shower immediately or
2. Roll on the floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if a blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press the wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you are not sure, ask!

Defined Roles

TA	The first point of contact for lab supervision	
IBEHS Lab Technician	Leela Pilli	pillil@mcmaster.ca
IBEHS Instructional Assistant	Parmveer Bola	bolap1@mcmaster.ca
IBEHS Wet Lab Tech	Andrej Rusin	rusina@mcmaster.ca
IBEHS Co-Directors	Dr. Greg Wohl Dr. Michelle MacDonald	wohlg@mcmaster.ca macdonml@mcmaster.ca
IBEHS Program Manager	Alexa Behar-Bannelier	alexa.behar@mcmaster.ca
IBEHS Course Instructor	Please contact your specific course instructor directly	