ELEC ENG 3BA3
Structure of Biological Materials
Fall 2017
Course Outline

CALENDAR/COURSE DESCRIPTION

Structure of natural and synthetic biomaterials, biocompatibility; biomechanics; physiological fluid mechanics; drug delivery and artificial organs; imaging of biological tissue structure.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in Level III or greater in Electrical and Biomedical Engineering

SCHEDULE

Lectures: Tuesdays, Thursdays and Fridays 11:30 a.m. – 12:20 p.m. in ABB-270
Tutorial: Friday 9:30 – 10:20 a.m. in JHE-A101

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Ian Bruce
ITB-A213
e-mail: ibruce@mail.ece.mcmaster.ca
e-mail alias: ibruce@ieee.org
For MSAF use: brucei@mcmaster.ca
ext. 26984

Office Hours:
T.B.A.
Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Taylor, Larissa
ETB-432
taylorla@mcmaster.ca

Office Hours:
T.B.A.

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

http://www.ece.mcmaster.ca/~ibruce/courses/EE3BA3_2017.htm
COURSE OBJECTIVES

1. to provide an introduction to bioengineering from a basis of the structure and function of biological materials;
2. to examine the structural foundations of several biomedical engineering technologies that will be studied in later courses; and
3. to give an introduction to bioengineering topics beyond the focus of the Electrical and Biomedical Engineering program.

ASSUMED KNOWLEDGE

- Algebra, trigonometry, functions, and calculus
- Basic chemistry and cell biology
- Fundamental statics and dynamics of rigid bodies
- Basic electromagnetics and electronics
- Fundamental mechanics of materials

COURSE MATERIALS

Main References:

Other Secondary References:

Other Materials:
Lecture notes will be posted on the course web site

Calculator:
Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.
# COURSE OVERVIEW

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Biomedical Engineering; Bioethics</td>
<td>Madihally §11</td>
</tr>
<tr>
<td>2</td>
<td>Biomaterials</td>
<td>Madihally §5.3; §6.1–6.4; §11.4–11.5</td>
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<tr>
<td>3</td>
<td>Biomechanics</td>
<td>Madihally §5.2–5.4; §6.3.1–6.3.2</td>
</tr>
<tr>
<td>4 &amp; 5</td>
<td>Student Presentations on Biomaterials and Biomechanics</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Physiological Fluid Mechanics</td>
<td>Madihally §2.2.3; §4</td>
</tr>
<tr>
<td>7</td>
<td>Drug Delivery, Biosensors &amp; Artificial Organs</td>
<td>Madihally §2.2.2, 2.3 &amp; 2.6; §10.2.1, 10.2.4 &amp; 10.3.1; §9; §6.5; §7.4–7.5</td>
</tr>
<tr>
<td>8 &amp; 9</td>
<td>Student Presentations on Physiological Fluid Mechanics, Drug Delivery, Biosensors &amp; Artificial Organs</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Foundations for Medical Imaging</td>
<td>Madihally §8</td>
</tr>
<tr>
<td>11 &amp; 12</td>
<td>Student Presentations on Medical Imaging</td>
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Note that dates are approximate.

# ASSESSMENT

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Project presentation</td>
<td>20%</td>
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<tr>
<td>Midterm Quiz #1</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm Quiz #2</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
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The instructor reserves the right to choose the format (i.e., written or oral) of any deferred midterm or final exam in this course.

Please note that announcements concerning any type of graded material may be in any format (e.g., announcements may be made only in class, via the course e-mailing list, or on the course web site). Students are responsible for completing the graded material regardless of whether they received the announcement or not.

# ACCREDITATION LEARNING OUTCOMES

Note: The Learning Outcomes defined in this section are measured throughout the course and form part of the Department’s continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student’s actual grade in the course. For more information on accreditation, please ask your instructor or visit: [http://www.engineerscanada.ca](http://www.engineerscanada.ca).

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Indicators</th>
<th>Measurement Method(s)</th>
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<tbody>
<tr>
<td>understand the structural make-up of biological tissues and how synthetic biomaterials interact with them</td>
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<tr>
<td>Identify a range of suitable engineering fundamentals (including applicable physics equations and mathematical techniques) that would be potentially useful for analyzing a biomechanics problem</td>
<td>2.2</td>
<td>Midterm Quiz or Final Exam Question</td>
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<tr>
<td>Understand the fundamentals of fluid mechanics and how they apply to blood flow and respiration</td>
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<td>Appreciate different approaches to developing artificial organs, including bioartificial and tissue-engineered organs</td>
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<td>Identify the advantages and disadvantages of different drug delivery approaches based on how they interact with the structure of biological tissues</td>
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<tr>
<td>Understand the physical basis of different medical imaging modalities and recognize what aspects of the tissue structure lead to formation of the image</td>
<td>1.4</td>
<td>Midterm Quiz or Final Exam Question</td>
</tr>
<tr>
<td>Draw from a diversity of relevant sources when conducting a literature review on a topic in biomedical engineering</td>
<td>12.2</td>
<td>Project Presentation</td>
</tr>
<tr>
<td>Clearly and concisely present the results of a literature review to the class</td>
<td>7.2</td>
<td>Project Presentation</td>
</tr>
<tr>
<td>Apply a bioethical framework and reasoning to an issue in biomedical engineering where there may be conflicting interests among the stakeholders</td>
<td>10.2</td>
<td>Midterm Quiz or Final Exam Question</td>
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**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](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 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

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": http://www.mcmaster.ca/msaf/

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.
Information for Laboratory Safety and Important Contacts

This document is for users of ECE instructional laboratories in the Information Technology Building.

This document provides important information for the healthy and safe operation of ECE instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in ECE. 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.

General Health and Safety Principles

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

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.

Location of Safety Equipment

- **Fire Extinguisher**
  - On walls in halls outside of labs

- **First Aid Kit**
  - ITB A111, or dial “88” after 4:30 p.m.

- **Telephone**
  - On the wall of every lab near the door

- **Fire Alarm Pulls**
  - Near all building exit doors on all floors
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 floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if 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 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’re not sure, ask!
In general, leave equipment in a safe state when you finish with it. When in doubt, consult the course TA.

Defined Roles
<table>
<thead>
<tr>
<th>Role</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>The first point of contact for lab supervision</td>
</tr>
<tr>
<td>ECE Lab Supervisor</td>
<td>Steve Spencer- ITB 147 <a href="mailto:steve@mail.ece.mcmaster.ca">steve@mail.ece.mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Chair</td>
<td>Tim Davidson- ITB A111 <a href="mailto:davidson@mcmaster.ca">davidson@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Administrator</td>
<td>Kerri Hastings- ITB A111 <a href="mailto:hastings@mcmaster.ca">hastings@mcmaster.ca</a></td>
</tr>
<tr>
<td>ECE Course Instructor</td>
<td>Please contact your specific course instructor directly</td>
</tr>
</tbody>
</table>