



Course Outline

Instructor

- Prof. Elham Salimi, E.I.T.
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Office Hours

- By appointment

Contact Hours

- 4 credit hours
- Lectures:
3 hours x 13 weeks = 39 hours
- Laboratories:
3 hours x 5 weeks = 15 hours

Prerequisites:

- ECE 3590 Electromagnetic Theory or instructor permission.

Course Website:

<http://umanitoba.ca/umlearn>

Important Dates

- **Term Test**
Tuesday, March 3rd, 2020
(in class)
- **Voluntary Withdrawal Deadline**
March 18th, 2020
- **Louis Riel Day**
February 17th, 2020
No classes or examinations
- **Spring Break**
February 18th – 21st, 2020
No classes or examinations

ECE 4860 T09 – Bioelectromagnetics

Winter 2020

Course Objectives

From extremely low frequency (ELF) fields of power lines to radiofrequency (RF) radiation of mobile phones to x-ray radiation for medical imaging, we are unintentionally or deliberately exposed to electromagnetic fields. The objective of this course is to learn how electromagnetic fields interact with the body (tissues and cells), how they are measured and controlled (dosimetry), and how they are employed for diagnostic and therapeutic purposes.

Course Content

- Basic concepts in electromagnetic fields
- Electromagnetic properties of tissues
- Interaction of extremely low frequency electromagnetic fields with biological systems
- Interaction of radiofrequency electromagnetic fields with biological systems
- Bioelectromagnetic dosimetry
- Bioeffects of electromagnetic fields
- Electromagnetic fields for therapeutic applications

Other Resources

C. Furse, D. Christensen, C. Durney, Basic Introduction to Bioelectromagnetics (Taylor and Francis, 2009)

Learning Outcomes

1. Understand the fundamental principles of interaction of EM fields with the body
2. Understand the standards and guidelines of EM fields exposure
3. Understand the principles of dosimetry in bioelectromagnetics
4. Being able to numerically (software-based) model the interaction of electromagnetic fields with a biological system.

Expected Competency Levels

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

CEAB Graduate Attributes Assessed

IN.3 – Interprets results and reaches appropriate conclusions.

IE.1 – Understands the social, environmental, economic, health, safety, legal and/or cultural aspects of engineering activities.

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 80%
- Engineering Design: 20%

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 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

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

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.

Evaluation

The final course grade is determined by the student's performance on assignments, in laboratories, and on tests and examinations.

Students must complete all laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments	10	F, S	1, 2, 4
Laboratories	15	F, S	1, 3, 4
Term Test	25	F, S	1, 2, 3
Final Examination	50	S	1, 2, 3, 4

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

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

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- 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 also 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.
- 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.
- 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 Information](#)

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.