

**UNIVERSITY OF GUELPH
SCHOOL OF ENGINEERING
ENGG*3170
BIOMATERIALS
Fall 2012**

Instructor: Dr. Ryan Clemmer (rclemmer@uoguelph.ca)

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Office hours: By appointment

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Text: J.S. Temenoff and A.G. Mikos, "Biomaterials: The intersection of Biology and Materials Science,"
Pearson Prentice Hall, 2008

i>clickers: May be purchased from the bookstore and are required for quizzes. Your i>clicker must be registered for your quiz marks to count towards your final grade.

Lecture Times: Tue 7:00 – 9:50 PM ROZH 102

Lab Times: Mon 1:30 – 3:20 PM THRN 2193
Tue 11:30 – 1:20 PM THRN 2193
Thu 11:30 – 1:20 PM THRN 2193
Fri 1:30 - 3:20 PM THRN 2193

Course Description:

The physical properties of natural and synthetic (e.g. stainless steel, polymers) materials used in biological engineering applications are introduced. Topics will include microstructure and mechanical properties of typical biomaterials, quantification of advanced material properties and behaviours, fabrication, compatibility, biodegradation and mechanical failure. Typical applications will include processing of biomaterials as well as equipment and implant design.

Learning Objectives

This course introduces the application and properties of biomaterials with the following objectives:

- Describe the general properties of natural and synthetic biomaterials
- Understand the link between the atomic structure of a material and its macroscopic properties and how to manipulate the microstructure to alter material properties through assignments, quizzes, and exams
- Summarize the complex interactions between biological systems and the materials used within these systems
- Predict which materials are most appropriate for a given application when designing biomaterial components by completing individual assignments

Course Notes

The lectures will revolve around a sequence of PowerPoint slides with elaboration and examples during the lectures. These will be generally available on Courselink before the lecture – it is expected that you will have a copy of these available during the lectures.

Schedule of Topics

Topic	Temenoff & Mikos Reference Chapters	Approx. Date(s)	Approx. # of Lectures
Introduction: Course Outline and Course Expectations		Sept. 11	1
Review of Basic Materials Science Concepts with Biological Applications: Chemical Bonding, Tensile and Compressive Loading, Thermal, Mechanical and Surface Properties, Failure Mechanisms	2, 3 & 4	Sept. 18, 25	2
Conventional Replacements for Biological Materials: Metals, Polymers, Ceramics, and Composites	6	Oct. 2	1
Biological Materials: Cartilage, Soft-Tissue, and Bone	Supplementary Notes	Oct. 9, 23	2
MIDTERM EXAM (in class)		Oct. 16	1
Alternative Biological Replacements: Tissue Engineering, Corrosion, and Wear	5	Oct. 30, Nov. 6	2
Cell Response: Engineering Aspects, Inflammation and Infection	7, 8, & 9	Nov. 13, 20	2
Testing Methods of Biological Performance and Ethics	10, 11, & 12	Nov. 27	1
Review		Nov. 27	1

Method of Evaluation

Final grades will be determined in the following manner:

Quizzes	10%
Lab Reports	25%
Midterm Exam	25%
Final Exam	<u>40%</u>
Total	100%

Note: Students must achieve at least 50% of the marks assigned to the midterm and final exams in order for the labs and quizzes to be counted in the final grade.

Assignments

Study Assignments will be posted periodically throughout the semester, with the solutions to follow about one week later. Assignments will not be marked. It is strongly recommended that you work through these assignments as they are valuable study aids and similar to the types of questions that may be asked on an exam.

Quizzes

There will be several i>clicker quizzes during the lectures throughout the semester. Students are expected to be present and use their own i>clicker during these quizzes. The quizzes are intended to help you better understand the course content and account for 10% of the course marks. You will receive 1 mark for each question answered and an additional 2 marks if the answer is correct. Prior to the first quiz, you must register your i>clicker serial number by clicking on the “*Student i>clicker Registration*” link on the right side of the webpage: <http://www.tss.uoguelph.ca/lhci/clickers/index.cfm>

Laboratory Reports

The laboratory forms an important part of the course; material introduced in the lab may be part of the midterm and final exams. There are 4 labs and a Lab Safety and Introduction session for the course that take place during the semester:

Lab

Lab Orientation and Introduction
Tensile Test of Dental Material
Anisotropy – Compressive testing of bone
Fatigue Testing of Metals
Determining Poisson’s Ratio of Cartilage

- An introductory lab session, including laboratory safety and group sign-up will take place the week of **September 24th**. The laboratory activities will start the week of **October 1st**.
- The laboratory work is group based. You will need to organize yourselves into **groups of three (3) or four (4) within your lab section by Friday, September 28st**. The sign-up sheets for lab groups will be available in the Biomaterials Lab in THRN 2193 during the lab orientation session. **Remember your group number.** Each group will be responsible for conducting the labs and writing a single report for each lab. You will be equally responsible for your group’s laboratory reports. Each group member must contribute to the writing of the lab report and sign the lab report cover page in order to receive a lab report mark. **Be sure to choose your lab partners wisely!**
- **Attendance at all labs is mandatory.** Anyone not attending the lab will not receive marks for that lab, irrespective of his/her contribution to the report. Failing to hand in a lab report before they are returned to the class will result in a mark of zero on that report.
- **You will not be allowed to do the labs unless you attend the safety session and sign a form indicating that you have done so.**
- **Laboratories:**
 - a) All lab reports must be submitted for marking in the assignment drop-off cabinet located in the engineering alley by the Machine Shop (THRN 1015) by 4:00 PM one week after the laboratory is performed. (Labs due on Thanksgiving Monday (Oct. 8) can be handed in on Tuesday, October 9th by 4:00 PM). **There will be a late penalty of 10 %/day or part thereof.**
 - b) Lab reports will be marked and the marks posted on Courselink. **Note that up to 20% of the lab mark may be deducted for poor lab report format, poor graph or table format, or poor English (spelling, grammar, etc.).** Any reports judged to be entirely unacceptable will be returned without marking for rewriting. Lab reports will be handed back to the group during the lab session after all

reports for that specific lab have been handed in. If you have questions about your mark, see the GTA responsible for that lab and they will discuss it with you.

- c) The labs begin the week of **October 1st**, according to the group schedule. Make sure you remember the schedule for your group when you sign up. You should download and print a copy of the ENGG*3170 Lab Manual from Courselink. **Be sure to carefully read the specific manual section before you go to perform each of the laboratory exercises.**
- d) All reports must be your own original work. Any material taken directly from other refereed sources such as text books, handbooks or journal articles must be properly referenced. Please note that most web pages are not refereed and, therefore, are not normally considered to be reliable sources of information for engineering purposes. Submission of reports that contain unreferenced, copied, or plagiarized material from other student reports or other external sources is considered an academic offence and will be forwarded to the Dean of the College of Physical and Engineering Science for consideration of Academic Misconduct.

Midterm Examination

A midterm examination will be given on **Tuesday, October 16th**, during the normally scheduled class time. You are allowed one single-sided 8.5" x 11" note sheet for the exam. Each note sheet must be prepared by you and be your own original work. If the midterm is missed due to an accepted verification of illness, the weighting of the final will increase to 65%; otherwise, the midterm will be given a mark of zero.

Final Examination

The final examination is scheduled for **Monday, December 3rd from 7:00 to 9:00 PM** (room TBA). You are allowed one double-sided 8.5" x 11" note sheet for the exam. Each note sheet must be prepared by you and be your own original work.

Major Holy Days

Students must contact the instructor within the first two weeks of class if academic consideration is to be requested because of religious reasons.

University Policy on Academic Misconduct:

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the Undergraduate Calendar 2012-2013 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Disclaimer:

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.