

# BIOMEDICAL MATERIALS

**BME 3101**

**Section:** 23B6

**Academic Term:** Spring 2020

**Class Periods:** T: Period 5-6 / Th: Period 6

**Location:** CSE E119

**Instructor:**

Jon Dobson

**Email:**

jdobson@ufl.edu

**Office Hours:**

TBD

**Teaching Assistants:**

N/A

## Course Description

This course focuses on the restoration of physiological function by engineering biomaterials for the biological environment, covering the principles underlying the use and design of medical implants and matrices/scaffolds. A strong emphasis will be placed on the transition from the engineering material to the biological tissue, including molecular and cellular interactions with biomaterials, tissue and organ regeneration, and the design of intact, biodegradable, and bio-replaceable materials.

## Course Pre-Requisites / Co-Requisites

Pre-Requisites:

BME3060: BME Fundamentals with a minimum grade of C

CHM3217: Organic Chemistry (or equivalent of CHM3217 according to the BME Curriculum Map)

Co-Requisites: None

## Course Objectives

Students who complete Biomaterials will understand the following principles:

- Understand the fundamental principles in biomedical materials, material science and chemistry, and how they contribute to biomaterial development and performance
- Biomaterial degradation in the biological environment
- Wound healing and tissue remodeling in the absence and presence of implants
- Molecular and cellular interactions with biomaterials
- Comparative analysis of permanent and biodegradable implants
- The fundamentals of tissue engineering and scaffold design

**Professional Component (ABET):** 1

## Relation to Program Outcomes (ABET):

| ABET Outcome  | Coverage* |            |
|---|-----------|------------|
| 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics  | High      | Reinforced |
| 2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors                   |           |            |
| 3. an ability to communicate effectively with a range of audiences  |           |            |
| 4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts |           |            |
| 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives   |           |            |
| 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions  |           |            |
| 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies   | Low       | Introduced |

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

### **Required Textbooks and Software**

- Title: Biomaterials: The Intersection of Biology and Materials Science  
Authors: Temenoff and Mikos  
Publication date and edition: 2008, first edition  
ISBN number: 978-0130097101

### **Recommended Materials**

- Title: Biomaterial Science  
Author: Buddy D. Ratner  
Publication date and edition: 2012, third edition  
ISBN number: 978-0123746269

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance is not required. However, class notes will not be provided to absent students, unless they have excused absences. Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

This course is a traditional lecture based course, and use of computers, tablets, and cell phones is distracting to your fellow classmates. Computers, tablets, and cell phones are not appropriate for use during this class and must be put away during class.

Unless prior arrangements or an excused absence has been granted by the instructor, students will be deducted 2 letter grades for late coursework (grading will start at 75% [C]). The deduction occurs at the time the work is due. Once the assignment has been handed back and the key discussed, a zero will be assigned late assignments that are not excused. Students with an excused absence shall be permitted a reasonable amount of time to make up the material or activities covered in their absence.

### **Evaluation of Grades**

| <b>Assignment</b> | <b>Percentage of Final Grade</b> |
|-------------------|----------------------------------|
| Exam #1           | 20%                              |
| Exam #2           | 20%                              |
| Exam #3           | 20%                              |
| Exam #4           | 20%                              |
| Quizzes           | 15%                              |
| Homework          | 5%                               |

\*No cumulative final

### **Grading Policy**

A: 90-100    B+: 87-89    B: 83-86    B-: 80-82    C+: 77-79    C: 73-76    C-: 70-72  
D+: 67-69    D: 63-66    D-: 60-62    E: <60

For information on current UF grading policies for assigning grade points, please visit:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>.

A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: A C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. More information on UF grading policy may be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>.

### **TENTATIVE Course Schedule**

| <b>Date</b>   | <b>Lecture Topic</b>   | <b>Notes</b>                 |
|---------------|--|------------------------------|
| Jan. 7 (T)    | Introduction & course overview                                     |                              |
| Jan. 9 (Th)   | Atomic structure & chemical bonding                                |                              |
| Jan. 14 (T)   | Atomic structure & chemical bonding     Crystalline Structure      |                              |
| Jan. 16 (Th)  | Crystalline Structure  |                              |
| Jan. 21 (T)   | Defects in Crystal Structures     <b>QUIZ 1</b>                    |                              |
| Jan. 23 (Th)  | <b>Exam Review</b>   |                              |
| Jan. 28 (T)   | <b>EXAM 1</b>  |                              |
| Jan. 30 (Th)  | Diffusion  |                              |
| Feb. 4 (T)    | Phase Diagrams   |                              |
| Feb. 6 (Th)   | Structure & Composition: Metals & Ceramics                         |                              |
| Feb. 11 (T)   | Structure & Composition: Polymers                                  |                              |
| Feb. 13 (Th)  | Physical & Mechanical Properties of Biomaterials                   |                              |
| Feb. 18 (T)   | Physical & Mechanical Properties of Biomaterials     <b>QUIZ 2</b> |                              |
| Feb. 20 (Th)  | <b>Exam Review</b>   |                              |
| Feb. 25 (T)   | <b>EXAM 2</b>  |                              |
| Feb. 27 (Th)  | Thermal & Optical Properties                                       |                              |
| March 4 (T)   | <b>SPRING BREAK</b>  |                              |
| March 6 (Th)  | <b>SPRING BREAK</b>  |                              |
| March 11 (T)  | Electrical & Magnetic Properties                                   |                              |
| March 13 (Th) | Magnetic Biomaterials: Applications                                |                              |
| March 17 (T)  | Surface Properties, Measurement Techniques     Biocompatibility    |                              |
| March 19 (Th) | Cell Biomaterial Interactions                                      |                              |
| March 24 (T)  | Tissue Engineering & Scaffold Design     <b>QUIZ 3</b>             |                              |
| March 26 (Th) | <b>Exam Review</b>   |                              |
| March 31 (T)  | <b>EXAM 3</b>  |                              |
| April 2 (Th)  | Tissue Engineering & Scaffold Design                               |                              |
| April 7 (T)   | Biomaterials & Wound Healing                                       |                              |
| April 9 (Th)  | Regulatory Considerations and Testing                              |                              |
| April 14 (T)  | Thrombosis and the Role of Biomaterials in Vasculature             | <b>QUIZ 4</b> will be online |
| April 16 (Th) | <b>Exam Review</b>   |                              |
| April 21 (T)  | <b>EXAM 4</b>  |                              |
|               |  |                              |

### **Students Requiring Accommodations**

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### **University Honesty Policy**

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Software Use**

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### **Student Privacy**

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### **Plagiarism**

Plagiarism is a common infraction to the UF Honor Code. If you are confused as to what constitutes plagiarism, see here: <https://guides.uflib.ufl.edu/copyright/plagiarism>. Plagiarism on any of your assignments **will be reported to the Dean of Students as a UF Student Honor Code violation**. Also, note that **copying solutions for any assignment, regardless of the source (e.g. other students, pirated website solutions), will be treated as plagiarism**. If you have any questions or concerns, please consult with the instructor in this class. Note that failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures.

## Campus Resources:

### Health and Wellness

#### **U Matter, We Care:**

At UF Every Gator Counts. U Matter, We Care serves as UF's umbrella program for UF's caring culture and provides students in distress with support and coordination of the wide variety of appropriate resources. Families, faculty and students can contact [umatter@ufl.edu](mailto:umatter@ufl.edu) seven days a week for assistance for students in distress. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** The counseling and wellness center provides resources for students in distress, including but not limited to suicide prevent, crisis management, advice on parenting a college student, and advice on adjusting to college life. <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Assault Recovery Services (SARS):** Sexual assault recovery services are available in the Student Health Care Center, contact at 392-1161.

**University Police Department** provides security and police services to the University of Florida. Contact at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### Academic Resources

**E-learning technical support:** Technical support for the Universities e-learning websites is available. Contact at 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center:** Whether it's connecting dots to figure out your interests or finding ways to connect with opportunities, the University of Florida Career Resource Center (CRC) is here to help you figure it out. The CRC focuses on your interests and experiences – not just your major. They can help you make sense of where you've been and show you where you can go. Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support:** Librarians are available to help you identify resources related to this course material. Contact at <http://cms.uflib.ufl.edu/ask> for various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center:** The mission of the Teaching Center at the University of Florida is to empower students to become successful lifelong learners. Through a variety of services and instructional approaches, the Teaching Center seeks to help students master effective ways of learning for different disciplines, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall, 846-1138.** The writing studio provides help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** The University of Florida believes strongly in the ability of students to express concerns regarding their experiences at the University. The University encourages its students who wish to file a written complaint to submit that complaint directly to the department that manages that policy. Information available at [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf) and <http://www.distance.ufl.edu/student-complaint-process>.

### **Commitment to a safe and inclusive learning environment**

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination.

It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@ufl.edu](mailto:nishida@ufl.edu)

### *Sexual Discrimination, Harassment, Assault, or Violence*

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)