

## Biomedical Materials

### BME 3101

**Class Periods:** M, W, F; Period 8 (3:00PM – 3:50PM)

**Location:** Larsen Hall, Room 330 (LAR 330) <https://campusmap.ufl.edu/#/index/0722>

**Academic Term:** Spring 2025

#### **Instructor:**

Benjamin Keselowsky (he/him/his)

bgk@ufl.edu (but please contact through the Canvas messaging system)

(352) 273-5878

Office Hours: Monday 4:00 pm by Zoom

(<https://ufl.zoom.us/j/93563699656?pwd=RzRXUlc1dXBuODBwckg1K0NDZTk1UT09>), or in-person by appointment

#### **Supervised Teaching Student:**

Cameron Crouse

cameroncrouse@ufl.edu (but please contact through the Canvas messaging system)

#### **Course Description**

This course focuses on the restoration of function by engineering biomaterials to function in physiological environments. Principles underlying the use and design of medical implants and matrices/scaffolds are covered. Emphasis will be placed on the structure/function relationship of engineered materials and the molecular and cellular interactions with biological tissue, as well as aspects of biomaterials design. (3 credits)

#### **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 Biomedical Materials 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

#### **Materials and Supply Fees**

None

#### **Relation to Program Outcomes (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 covered or assessed in the course.

### ***Required Textbooks and Software***

- None

### ***Recommended Materials***

- Biomaterials: The Intersection of Biology and Materials Science  
Temenoff and Mikos  
Publication date and edition: 2008, first edition  
ISBN number: 978-0130097101
- Biomaterials Science  
Wagner, Sakiyama-Elbert, Zhang, Yaszemski  
Publication date and edition: 2020, fourth edition  
ISBN number: 978-0-12-816137-1
- Materials Science and Engineering, An Introduction  
William D. Callister, Jr., and David G. Rethwisch  
Publication date and edition: 2018, 10<sup>th</sup> edition  
ISBN-13: 9781119321590

### ***Course Schedule***

The schedule is tentative and subject to change. See Canvas course site for updated course schedule with dates. The following topics will be covered in this course:

- Atomic, Chemical, and Crystalline Structure
- Structure and Composition of Biomaterials
- Biomaterials Processing
- Material Properties
- Biological Interactions with Biomaterials
- Biomaterials for Tissue Engineering and Scaffold Design

### ***Class Website***

- Canvas (elearning.ufl.edu) will be used extensively, including posting all assignments and grades.
- Each student is fully responsible for ensuring that they have access to Canvas and must check the course website routinely to ensure they are fully aware of all assignments and postings.
- Failure to check the course website will not be a valid excuse for not completing assignments.

## ***Class Policies (Attendance Policy, Class Expectations, and Make-Up Policy)***

### Attendance Policy:

The health and safety of you and others comes first, therefore I trust you will make the best to keep yourself and those around you safe, and to attend our class when it makes sense to do so.

- Students are expected to attend and participate in the lectures in person.
- All assignments, including quizzes and exams will be submitted via Canvas.
- Exams will be offered in-person via Canvas and all students are expected to be in attendance in-person during the exam. Release of the test and submission online will occur at the beginning and end of the class period, respectively.
- Quizzes will be offered asynchronously via Canvas and have a set deadline (e.g. 11:59pm EST). See Canvas course site for more details. Quizzes must be completed individually with no collaboration.
- It is your responsibility to keep up to date on the course assignments and due dates.
- Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>) and require appropriate documentation

### Class Expectations:

#### *Professional and respectful conduct:*

- Students are expected to engage in a courteous and professional manner.
- Students are expected to treat others with respect, tolerance, fairness, and justice.
- I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise of this preference early in the semester.
- Any student who behaves in a disrespectful or disorderly manner may be asked to leave the classroom.

#### *Communication:*

- You are required to use Canvas for class communications.
- All communication should be conducted in a professional manner.
- Class announcements will be posted to Canvas.

### Make-Up Policy

#### *Homework/Quizzes:*

- Unless prior arrangements or an excused absence has been granted by the instructor, students will be deducted 2 letter grades for late homework (grading will start at 75% [C]).
- The deduction occurs at the time the work is due.
- Once 48 hours after the due/time has passed, a zero will be assigned for late assignments that are not excused.
- Students with an excused absence shall be permitted a reasonable amount of time to make up the assignment.
- In the case of technical issues with Canvas while completing your assignment, send a Canvas message with documentation prior to the time the assignment is due. Additional time to complete the assignment will be up to the discretion of the instructor.

#### *Exams:*

- Make-up exams are permitted only for documented university approved excused absences.
- In general, acceptable reasons for excused absence include illness, serious family emergencies, special curricular requirements, military obligation, court-imposed legal obligations, and religious holidays. In all cases, you will be required to provide written documentation, and obtain prior instructor approval.
- You must notify the instructor no less than 1 week prior to the scheduled exam.
- In the case of an emergency that prevents prior notification of an anticipated missed exam, you must notify the instructor as soon as possible.

- Please review your student handbook to ensure that you understand the requirements for a university approved absence. Excused absences are consistent with university policies and require appropriate documentation. (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>).

### **Evaluation of Grades**

<b>Assignment</b>	<b>Percentage of Final Grade</b>
Homework (participation, surveys, discussion boards, etc)	10%
Quizzes	15%
Exams (4 equally weighted)	75%
Total	100%

\*No cumulative final exam

\*\* The grades shown in Canvas are provisional and do not take into account the correct weighting. If you want to calculate your grade, use the weighting in the table above.

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

The instructor reserves the right to adjust the grade distributions, however, grades will not be adjusted for individuals.

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Final cumulative numerical grades will be rounded to the nearest tenth of a point. Curving of assignments is exceptionally rare and typically only due to the entire class missing a question. **There is no curving of final grades.**

### **Re-Grade Requests**

Requests to modify points on assignments, quizzes, or exams must be submitted in writing to the instructor within 1 week from when the graded assignment was made available. The request should identify the question and provide clear justification/reasoning for the requested change. The instructor will then review the request and modify the grade, as necessary. The instructor also reserves the right to turn down unreasonable or frivolous grade challenge requests.

### **Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **Course Evaluation**

**BME 3101: Biomedical Materials**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens and can complete evaluations through the email, they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### ***In-Class Recording***

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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://sccr.dso.ufl.edu/process/student-conduct-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.

### ***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
- HWCoe Human Resources, 352-392-0904, [student-support-hr@eng.ufl.edu](mailto:student-support-hr@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@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students at 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: <https://registrar.ufl.edu/ferpa.html>

### ***Campus Resources:***

#### ***Health and Wellness***

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

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

##### **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)

##### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### ***Academic Resources***

**E-learning technical support**, 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**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

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

**Student Complaints Campus:** <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.