

Biomaterials: Structure and Properties

EMA 4061 Section CAMP (20382)

Class Periods: T, Period 4 (10.40 am – 11.30 pm); R, Period 4-5 (10.40 am – 12.35 am)

Location: NEB 0101

Academic Term: Fall 2025

Instructor:

Prajakatta Mulay, PhD

prajakatta@ufl.edu

(352) 846-3300

Office Hours: By appointment

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

N/A

Course Description

Materials commonly used for biomedical application, such as their properties from a biocompatibility or medical device perspective. In addition, materials interactions with biological systems are examined from the molecular (e.g., protein), cellular, tissue and systemic (whole body) perspective. This is the foundation for the second biomaterials class, which applies these principles toward the application of biomaterials in medical implants, prostheses and devices, along with the regulatory issues associated with biomaterials development.

Course Pre-Requisites / Co-Requisites

EMA 3066 – Introduction to Organic Materials

Course Objectives

This course will provide an introduction to the field of biomaterials used in the design of medical devices, and to augment or replace soft and hard tissues. Discussion will include the bulk properties, applications, and in vivo behavior of different classes of natural and synthetic biomaterials. Analysis of the biological response including biocompatibility and hemocompatibility as well as failure processes of implantable biomaterials/devices. Finally, evaluations of relevant case studies covering biomaterial approaches will be conducted.

Materials and Supply Fees

N/A

Relation to Program Outcomes (ABET):

This course provides 3 credits towards engineering sciences.

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Medium
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	Medium
3. An ability to communicate effectively with a range of audiences	Medium
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	Medium

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives	Low
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Low
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Medium

Recommended Materials

- Biomaterials Science: An Introduction to Materials in Medicine
- Wagner, Sakiyama-Elbert, Zhang, Yaszemski
- 2020, 4th Edition
- Academic Press ISBN: 9780128161371

OR

- Biomaterials Science: An Introduction to Materials in Medicine
- Buddy D. Ratner et. al.
- 2013, 3rd Edition
- ISBN: 978-0123746269

Other reference material will be provided throughout the class.

Required Computer

Recommended Computer Specifications: <https://it.ufl.edu/get-help/student-computer-recommendations/>
HWCOE Computer Requirements: <https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/>

Course Schedule

Below is the intended/tentative schedule of classes and exams. The instructor reserves the right to make changes to the syllabus as needed. Any changes will be clearly announced on CANVAS and in class.

Week	Class #	Class Dates	Topic
1	1	Aug 21	Course Intro
2	2	Aug 26	History & MSE Review
	3	Aug 28	Characterization of Biomaterials
	4	Aug 28	Characterization of Biomaterials
3	5	Sep 2	Biomaterials and Biology
	6	Sep 4	Biomaterials and Biology
	7	Sep 4	Protein/Material Interactions
4	8	Sep 9	Protein/Material Interactions
		Sep 11	Exam 1
5	9	Sep 16	Metals in Medicine
	10	Sep 18	Metals in Medicine
	11	Sep 18	Metals in Medicine
6	12	Sep 23	Ceramics in Medicine
	13	Sep 25	Ceramics in Medicine
	14	Sep 25	Ceramics-BioGlass
7	15	Sep 30	Polymer in Medicine
	16	Oct 2	Polymer in Medicine
	17	Oct 2	Polymer in Medicine
8	18	Oct 7	Cell Material Interactions
		Oct 9	Exam 2

9	19	Oct 14	Cell Material Interactions
	20	Oct 16	Immunologic Response
	21	Oct 16	Immunologic Response
10	22	Oct 21	Wound Healing
	23	Oct 23	Blood Material Interactions
	24	Oct 23	Blood Material Interactions
11		Oct 28	Flex Day
		Oct 30	Exam 3
12		Nov 4	Student Presentations
		Nov 6	Student Presentations
13		Nov 11	No Class – Veterans Day
		Nov 13	Student Presentations
14		Nov 18	Student Presentations
		Nov 20	Student Presentations
15		Nov 25	No Class – Thanksgiving Break
		Nov 27	No Class – Thanksgiving Break
16		Dec 2	Make-up Presentations

Important Dates

Sep 11 Exam 1 (Timed, Class 1-8)

Oct 9 Exam 2 (Timed, Class 9-17)

Oct 30 Exam 3 (Timed, Class 18-24)

Attendance Policy, Class Expectations, and Make-Up Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Attendance Policy: Lecture attendance is highly recommended. During certain parts of the class, attendance will be mandatory, and a lack of attendance will affect your grade. Experience has shown that those who attend lectures earn higher grades in the course. Arrival on time is expected. Excused absences are consistent with university policies in the undergraduate catalog

(<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>Links to an external site.) and require appropriate documentation.

Class Expectations: Please turn off all cell phones upon entering class. Reading of newspapers, work on assignments for this or other classes, or other activities that are not part of the class are not allowed during lecture. Students who do not comply with these requirements or who behave disorderly or disrespectfully may be asked to leave the classroom.

Exams: All of our exams will be during our regularly scheduled class time, therefore there should be no exam conflicts. There will be 3 exams throughout the semester. The exam content may change, and the dates are tentative and will be finalized after the add/drop period. Each exam is weighted equally, and total will be worth **45%** of your final grade. You have one week after the test results are posted to raise any questions about scores and grades with the instructor. No changes to your exam grade will be made after that time. There will be no final exam.

Concept Check Exercises/Homework: Periodically, students will be given a few questions to answer related to the lecture topics of the week. These questions check the students understanding of the current concepts being covered. The concept check exercises will be timed and administered and submitted via Canvas.

Biomaterials Project: Students will provide an oral lecture to the class and a written report on a biomaterial topic, selected from a list of topics. Details of this assignment will be provided separately.

Make-up exams: Make up exams will be provided only with the prior approval of the instructor in accordance with university policies. (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. In the case of an emergency that prevents prior notification of an anticipated missed exam, you must notify the instructor as soon as possible. You will not be excused from any exam without following the policy above, with no exceptions. Students not in attendance for the scheduled exam will receive a score of zero. To be clear, Make-up exams will only be allowed in exceptional cases, with prior instructor approval, sufficient documentation, and in accordance with university policies. (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>). **You must notify the instructor no less than 1 week of the scheduled exam. Make-up exams for excused absences must occur within 1 week of the missed exam and may occur before the missed exam.**

Communications: This course will use CANVAS extensively as a communication and archival tool. Students can access all relevant course information (course notes, homework, problem sets, solutions, announcements, grades, etc.) via the CANVAS. **Communications to the Instructor should be sent through the CANVAS website to ensure timely response.**

Evaluation of Grades

Assignment	Percentage of Final Grade
Concept Check Exercises/Homework Sets	15%
Biomaterials Project Presentation	15%
Biomaterials Project Report	15%
Exams	45%
Participation (Discussion Boards, Attendance, Peer Evaluations)	10%
	100%

Grading Policy

Final letter grade will be assigned based on a student's overall performance during the semester. The following scale will be used as a guideline.

Percent	Grade	Grade Points
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

More information on UF grading policy may be found at:

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

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

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.bluer.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-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://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 or TAs in this class.

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.

Commitment to a Positive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values.

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 Undergraduate Coordinator
- HWC OE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@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>

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://elearning.ufl.edu/>.

Career Connections 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: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

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 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

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 Policies & Resources

Please visit academic policies and campus resources: <https://go.ufl.edu/syllabuspolices> for more information.