

## Biomaterials: Structure and Properties EMA 4061 Class Number 14143

**Class Periods:** Tuesday/Thursday, period 2/3  
(Tuesday- 8:30 am- 10:25 am, Thursday- 9:35 am- 10:25 am)

**Location:** Tuesday- WEIM 1094, Thursday- FAC 0127

**Academic Term:** Fall 2021

**I. Professor:**

Erika Moore (she/her/hers)

[moore.erika@ufl.edu](mailto:moore.erika@ufl.edu)

(352) 846-3328

Office Hours: To occur Tuesdays 8:30 am – 9:30 am and via appointment

**II. Teaching Assistants:**

Noah D. Ferson

[noah.ferson@ufl.edu](mailto:noah.ferson@ufl.edu)

**III. Course Description**

(3 credit hours) – 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.

**IV. Course Pre-Requisites / Co-Requisites**

EMA3066

**V. Course Objectives**

This course will introduce 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.

**VI. Materials and Supply Fees:**

None

**VII. Relation to Program Outcomes (ABET):**

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

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	Medium

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	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

### VIII. **Required Textbooks and Software**

Recommended:

Introduction to Biomaterials: Basic Theory with Engineering Applications

C. Mauli Agrawal, Joo I. Ong, Mark R. Appleford, Gopinath Mani

2014 (1<sup>st</sup> Edition)

Cambridge University Press ISBN: 0521116902

Other reference material will be provided throughout the class.

### IX. **Course Schedule (tentative and subject to change)**

Week	Date	Topic (T)	Topic (T)	Topic (Th)
1	23-Aug	Introduction	History	Surface vs. Bulk (1/2)
2	30-Aug	MSE Review	Surface vs. Bulk (2/2)	Biology 101
3	6-Sep		<b>Guest- T. Brennan</b>	Exam #1
4	13-Sep	Protein/Material Interactions	Protein/Material Interactions	Protein/Material Interactions (EXAM #1- returned)
5	20-Sep	Materials metals	Materials metals	STUDENT TEACH: #1
6	27-Sep	NO CLASS- CAREER FAIR		STUDENT TEACH: #2
7	4-Oct	Materials in ceramics	Materials ceramics	Article Discussion
8	11-Oct		<b>Guest- Amend Surgical</b>	Exam #2
9	18-Oct	Materials Polymers	Materials Polymers	STUDENT TEACH: #3 (Exam #2- returned)
10	25-Oct	Materials Polymers	Cell-Material Interactions	STUDENT TEACH: #4
11	1-Nov	Cell-Material Interactions	Foreign body response	STUDENT TEACH: #5
12	8-Nov		STUDENT TEACH: #6	NO CLASS- VETERANS DAY
13	15-Nov	Wound Healing	Preparation for Exam #3	Exam #3
14	22-Nov		<b>Guest United Therapeutics</b>	NO CLASS- THANKSGIVING
15	29-Nov	STUDENT TEACH: #8 (EXAM #3- returned)		STUDENT TEACH: #7
16	6-Dec	STUDENT TEACH: #9		NO 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.

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

- A. **Lecture Policy:** This course will cover a combination of live lectures and recorded lectures. Recorded lectures will be accessible through Canvas for one week. Live lectures will not be recorded. Research shows students learn and retain information best taking notes by hand (see *Scientific American: A Learning Secret - Don't take Notes with a Laptop*). It is highly encouraged that each student put their phone away, turn off notifications on their computer and email, and close irrelevant windows when watching lectures or participating in a group setting for this class.
- B. **Attendance Policy-** Students are expected to attend lectures and participate in the form of quizzes, exams, and discussion sessions. Attendance during examinations will occur via Zoom, each student is expected to be present during examinations. Submission of tasks assigned including quizzes and discussion boards is expected prior to the submission deadline. For ease and consistency, all tasks assigned in conjunction with lectures will be due on Mondays at 11:59 pm. All exams will occur on Thursdays. **Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.**

### **C. Class Expectations-**

**Contacting the Professor:** Students should use Canvas to contact me. While you may email me at the provided UF email account (with the subject line “EMA 4061”), the university strongly encourages communication via Canvas to avoid the potential of violations of student confidentiality protected by FERPA. I strongly encourage students to attend virtual office hours (Tuesdays at 8:30 am – 9:30 am) to discuss any questions or concerns regarding the course. If students do email me, they must use “EMA 4061” in the subject line to ensure a response.

**Messaging/Email Hours:** You may contact me via Canvas or email at any time that is convenient to you. I will respond within two business days between the hours of 9 am and 5 pm. If you do not receive a reply from me after 2 full business days, please resend your message. Responses cannot be guaranteed after 5 pm on weekdays, on weekends, or on academic holidays. Please plan accordingly to have your questions answered in advance of assignment and exam deadlines.

**Interpersonal Conduct:** Mutual respect for your classmates, myself, and yourself is expected in all communication; all class members are always expected to treat each other with respect, courtesy, tolerance, fairness, and justice.

**Effort:** The university recommends that students typically spend 9 to 12 h per week for a 3-credit class. This can of course vary but is a good initial guideline as the term begins.

**Recommendations for This Classroom:** For lectures, assignments, quizzes, and exams, it is in your best interest to ask questions or for clarification when content or a question is not making sense, so that we can review it or I can change approach.

**Referencing the Professor:** Often, students have questions over proper naming or titling etiquette for

communicating with their professors. In all communication with me throughout the duration of our course, please refer to me as Dr. Moore or Professor Moore.

- D. **Exams**- All our exams will be during our regular scheduled class time on Thursdays, therefore there should be no exam conflicts.

**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 of university policies (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>). You must notify the instructor no less than 1 week prior to 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.

#### **XI. Evaluation of Grades**

Assignment	Percentage of Final Grade
Exams (3 equally weighted)	45%
Quizzes	10%
Biomaterials Project	20%
Participation (including Discussion boards)	10%
Total	100%

**Exams:** There will be 3 in-class exams that must be taken during the scheduled course time (release of the test and submission online will occur at the beginning and end of the class period, respectively). **There will be no Final Exam.**

**Canvas Quizzes & Discussion Prompts:** Lectures will periodically have an associated quiz, question, or discussion prompt, which must be completed **by Mondays at 11:59pm**. Quizzes must be completed individually with no collaboration and should ideally be completed shortly or immediately after the lecture so the professor can assess what concepts or content should be revisited.

You have one week after an exam, homework, or other assignment is returned to resolve any questions about scores and grades. No changes to your assessment grades will be made after that time.

#### **Grading Policy**

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

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

For more information on UF grading policy, please visit: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

## **XII. 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 the instructor and discuss their access needs, as early as possible in the semester.

## **XIII. 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.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

## **XIV. 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/policies/student-honor-code-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 in this class.

## **XV. 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@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

## **XVI. 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.

## **XVII. 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>

## **XVIII. Campus Resources:**

### Health and Wellness

***You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated. Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.***

*If you are sick, stay home and self-quarantine. Please visit the [UF Health Screen, Test & Protect website](#) about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus. UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.*

*If a student who is withheld from campus attends class, the student should be asked to leave the classroom and be reported to the Dean of Students Office.*

#### **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:** <http://www.counseling.ufl.edu/cwc>, 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. <https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.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://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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