Instructor: Stephanie J. Bryant, PhD
Email: stephanie.bryant@colorado.edu

Meeting Time: TTh 1:00-2:15pm JSCBB A108

Course Website: We will use Desire2Learn (D2L). D2L will contain announcements, supplementary material, lecture material, homework assignments, grades, solutions, corrections, etc.

Email List: Email will be used for general correspondence and announcements including corrections to lecture, homework problems statements, etc. An email list will be generated from the class roster. Be sure to check your CU email account!


Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>5%</td>
</tr>
<tr>
<td>Reading Quizzes</td>
<td>5%</td>
</tr>
<tr>
<td>Topic Presentation</td>
<td>5%</td>
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<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Exam 1</td>
<td>20%</td>
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<tr>
<td>Exam 2</td>
<td>20%</td>
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<tr>
<td>Exam 3</td>
<td>20%</td>
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<tr>
<td>Final Term Paper and Presentation</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Homework will not count unless your exam average is 65% or better.**

**Homework:** Homework assignments will be due on Wednesday at 10 am unless otherwise stated. Some homework assignments may include reading and interpreting journal articles from the literature. All homework assignments must be done in groups of three or four unless otherwise specified as an individual assignment. For all group homework assignments, you will need to sign up for your group through D2L. Each problem must be separate (i.e., do not combine more than one problem on the same page). The entire assignment must be scanned and submitted to the appropriate Dropbox folder on D2L. Please ask before the first assignment is due if you have any questions.

**Reading Quizzes:** There will be reading quizzes before each class unless otherwise stated. Reading quizzes for the week will be made available starting at noon on the Friday before the week’s quizzes. Access will end at 10 am on the day of the class. Access will not be extended for any reason! Reading assignments will be provided on D2L.
Each reading assignment will be worth 10 points regardless of the number of questions. You should read the material first before completing the online quiz. You will have 1.5 hours to complete the quiz online. Answers to the reading quizzes will be provided on D2L, but only after access to the quiz has ended. I will drop your lowest score.

Class Participation: Class participation will be a combination of in-class worksheets and clicker questions (iClickers). In-class worksheets will be done in groups of two to three, unless otherwise specified, turned in immediately after class, and graded for accuracy and completeness. Clicker questions based on a combination of conceptual and numerical questions will be administered throughout the course. For clicker questions, a correct answer will be given 2 pts. An incorrect answer will be given 1 pt. No answer will receive 0 pts unless you did not participate or were absent. You will receive an overall percentage for that day in class, regardless of how many questions or the type of participation assessment. On days, where we have both clickers and worksheets, they will be weighted equally. In-class participation (i.e., clicker questions and in-class worksheets) cannot be made up, and you will not get credit if your clicker runs out of batteries, you left it at home, etc. so please don’t ask. I will drop your lowest class participation grade.

Topic Presentation:

- Students will work in groups of 4 unless otherwise assigned. Students have been randomly assigned to a group, a topic and day to present. Group assignments can be found on D2L under groups. The topic will be related to the lecture on that day.
- The group will perform a literature search and select one recent article that is closely related to the lecture topic and was published in the last ~3 years (publication date must be between 2014 and 2017). The article must be a research article, not a review article or perspective article. If you are unsure, ask!
- The group will give a 5 minute presentation summarizing the paper on the day they are assigned. Guidelines for the presentation are posted on D2L. All group members are required to present. Your group will be required to submit a pdf copy of the journal article on D2L via dropbox. If your presentation is on a Tuesday, you will be required to send the journal article to the TA by 5pm on Friday. If your presentation is on a Thursday, you will be required to send the journal article to the TA by 5pm on Monday. Failure to do so will lower your grade by 10%. This is important to ensure that other groups presenting do not select the same article. The article will be posted on CU Learn for others to read prior each presentation. Suggested journals will be provided on D2L.
- Should more than one group choose the same article, we will adhere to the following guidelines. The first group to submit their article will be allowed to present that article. The other group(s) must select a different article. It is in your best interest to submit the pdf of your article as soon. Before selecting an article, double check D2L for articles that have been submitted. If an article has been submitted, but not yet posted, we will notify the group by email if the article has already been selected by another group.

Exams: Three night exams will be given during the semester. The exams will be closed book/closed notes. The exams will cover the assigned material (note there will be material discussed in class that is not in the text), required reading sections in the text and any additional material, and all material covered in the reading assignments, in-class worksheets, clicker questions, and homework assignments. Exams will consist of multiple choice, true/false, matching, short answer, and/or quantitative problems. There will be no final exam. Any student who misses an exam will be dropped from the class unless he/she has a documented illness or similar catastrophe. If the student has an excused absence, the exam average will be based on the two other exams, which will be equally weighted.

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Thursday, Feb 16, 2017</td>
<td>7-8:30 pm</td>
<td>A108 and A104</td>
</tr>
<tr>
<td>#2</td>
<td>Wednesday, March 15, 2017</td>
<td>7-8:30 pm</td>
<td>A108 and A104</td>
</tr>
<tr>
<td>#3</td>
<td>Wednesday, April 19, 2017</td>
<td>7-8:30 pm</td>
<td>A108 and A104</td>
</tr>
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</table>
**Term Paper and Presentation:** Students will work in groups of 4 to prepare a proposal that focuses on the development of a novel approach for biomaterials. Your group’s approach should be to develop a novel biomaterial(s) or uniquely employ an existing biocompatible biomaterial(s) in order to either improve upon a current medical device or to develop an entirely new medical device. Each group will give a presentation of their proposal to the class at the end of the semester. All group members must be present and participate during their group’s final presentation. Any group member that is not present for their group presentation will receive a zero for their entire final project grade. *Attendance is MANDATORY and will be part of your grade!* Attendance will be graded on the days your group is not presenting. If you miss one day, you will lose 3 pts of your attendance grade. If you miss a second day, you will lose an additional 3 points. If you miss a third day, you will lose an additional 4pts. Additional information will be provided on D2L regarding the term paper and presentation. Every student must fill out a team assessment form on each member of their group. Team assessment forms can be found on D2L and are due at the time the final paper is due.

**Important due dates:**

**Feb 22, 2017:** Submit names of all members in your team before 10:00 am on the due date.
Submission is done via groups on D2L. Each team must consist of 4 members.

**March 15, 2017:** Submit a one page executive summary of your team’s proposed product. You must use the word file template provided to you. It can be found on D2L. You will need to provide at least 3 journal article references to demonstrate that such a biomaterial or approach is feasible and include at least 3 patents to illustrate the prior work in this area. You will need to provide a convincing case that your approach is feasible, but also novel. Submission will be done via the group submission with Dropbox on D2L before 10:00 am on the due date.

**April 25, 2017 - April 27, 2017** Project presentations will occur during this week at our normal class meeting time and in the evening at 7-8:50 pm in JSCBB A108. This is important to ensure that all groups have sufficient time to present. Each group will have a total of 13 min for their presentation (8 min presentation, 5 min question). Group presentation schedule will be selected at random. The maximum number of groups is 24.

**May 2, 2017 - May 4, 2017** There will be no class this week. You should be working with your group to finalize the written report.

**May 5, 2017:** 5:00 pm, Final Project Paper Due submitted on D2L.

**Grading Scheme for Final Project (out of 100pts):**

<table>
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<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Team Names</td>
<td>5</td>
</tr>
<tr>
<td>One Page Executive Summary</td>
<td>10</td>
</tr>
<tr>
<td>Presentation</td>
<td>20</td>
</tr>
<tr>
<td>Attendance*</td>
<td>10</td>
</tr>
<tr>
<td>Paper</td>
<td>50</td>
</tr>
<tr>
<td>Team Assessment</td>
<td>10</td>
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*Must be present EVERY day of the presentations to receive full points (see details above for more information on missing class). It is in your best interest to attend the all presentations.

**Excuses:**
No late homeworks will be accepted! No excuses for missed exams will be accepted other than certified medical or immediate family death.
Learning Goals:

1. **Basic concepts in material science**
   - Understanding of fundamental concepts in material science (e.g., atomic structure and bonding, crystalline structures and defects) and interpretation of phase diagrams
   - Understand major classes of materials used in medicine: metals, ceramics and polymers
   - **Polymers:** Ability to determine molecular weights and molecular weight distributions, understanding of glassy and rubbery states, ability to correlate structural features to mechanical properties (e.g., moduli, deformation, and viscoelasticity), knowledge of polymerization reactions (e.g., chain vs. step, thermoplastics vs. thermosets), knowledge of degradation mechanisms.
   - **Metals:** Knowledge of the basic structure and types of alloys (e.g., ferrous and nonferrous), ability to correlate structural features created in processing to general mechanical properties (e.g., stress-strain behavior, hardness, impact energy, fracture toughness, fatigue)
   - **Ceramics and Glasses:** Ability to characterize crystalline vs. noncrystalline materials, understanding of mechanical properties and processing methods in relationship to structural features (e.g., brittle fracture, static fatigue, thermal shock, viscous deformation).

2. **Biological response to biomaterials**
   - Familiarity with biocompatibility and hemocompatibility
   - Understand mechanisms of the foreign body response to implanted biomaterials
   - Understand biodegradation of biomaterials: intentional and un-intentional degradation mechanisms
   - Knowledge of techniques to modify biomaterial surfaces to control the biological response and instrumentation to examine surface chemistry

3. **Biomaterial applications**
   - Knowledge of biomaterial requirements for certain medical applications (e.g., biomaterials to be used in a joint versus a blood vessel).
   - Familiarity of biomaterials used in different medical applications (e.g., soft and hard tissue replacements, cardiovascular, drug delivery, biosensors, and tissue engineering).

4. **Biomaterials in Engineering Design**
   - Ability to apply fundamental principles for designing biomaterials to be used in a given medical application
   - Familiarity with legal and ethical issues related to biomaterials used in medical applications
Policies and Procedures

Honor Code: All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at http://honorcode.colorado.edu.

Disabilities: If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by email at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Injuries guidelines under the Quick Links at the Disability Services website and discuss your needs with your professor.

Religious Observances: Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, the student must notify the professor at the beginning of the semester within the first week of any conflicts with regard to their assigned presentation times.

Behavioral standards: Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the student code.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation: The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU’s Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.