Engineering Faculty Document No. 02-22
April 22, 2021

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: Change to Undergraduate-Level Course BME 20600 requisites and structure

The faculty of the School of Biomedical Engineering has approved the change in requisites and structure of the course listed below. This action is now submitted to the Engineering Faculty with a recommendation for fast-track approval.

FROM: **BME 20600 Biomechanics & Biomaterials Laboratory**
Term offered: Spring, Laboratory, Cr. 1, 16 weeks
Prerequisites: BME 20500, ME 27000 or ME 27100
Corequisites: BME 20400 and MSE 23000

Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing of tissue and body mechanics, and interactions of living (e.g., tissue/cell) and nonliving (e.g., biomaterial) systems. Typically offered Spring.

TO: **BME 20600 Biomechanics & Biomaterials Laboratory**
Term offered: Spring, Laboratory, Cr. 1, 16 weeks or 8 weeks
Concurrent Prerequisite: BIOL 23000

Provides hands-on training in engineering and biological principles of biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing of tissue and body mechanics, and interactions of living (e.g., tissue/cell) and nonliving (e.g., biomaterial) systems. Typically offered Spring.

REASON: Changes made to course to provide more curricular flexibility. The course schedule has been redesigned so that this course can be delivered as either a 16-week course, or an 8-week course; similar to consolidating courses for delivery in summer. The 8-week course has been piloted under a temporary BME 295 course number twice in Spring 2021. This change will now allow this course to be offered as an 8-week course in the summer as well as the spring. Pre-requisites also now accurately reflect knowledge needed for the course.

George R. Wodicka

George Wodicka
Professor and Head
Weldon School of Biomedical Engineering

BME 206
2019 Course Syllabus

Lab Coordinator:	Mr. Minku Kim Email: kim2139@purdue.edu	Office: MJIS 1053
Course TAs:	Ms. Xiaoyu Xu Email: xu966@purdue.edu	Office: MJIS 1053
	Ms. Dana Moryl Email: moryl@purdue.edu	Office: MJIS 1053
	Mr. Cheng Bi Email: bi19@purdue.edu	Office: MJIS 1053
	Ms. Mandira Marambe Email: mmarambe@purdue.edu	Office: MJIS 1053

Class Location: MJIS 1053

Hours:

Tuesday	10:30 AM – 1:20 PM
Tuesday	2:30 PM – 5:20 PM
Thursday	10:30 AM – 1:20 PM
Thursday	2:30 PM – 5:20 PM
Friday	8:30 AM – 11:20 AM

Office Hours: Mondays and Wednesdays 6 – 8 pm, MJIS 1053

Pre-requisites: BME 205 **Co-requisites:** BME 204

Course Description:
Introductory laboratory experience focused on integrating engineering and biological principles by exploring key topics in biomaterials and biomechanics. Topics include evaluation and interpretation of experimental results, modeling and testing tissue and body mechanics, and biomaterial/tissue interactions. At the conclusion of the semester students will present a theoretical design aimed at improving or developing a previously stated biomedical device.

Course Outcomes:
Upon completion of the course each student will be able to:

1. Implement biomolecular and cellular experimental concepts developed in BME 205 towards biomechanics and biomaterials.
2. Independently employ fundamental analytical tools and techniques used in the analysis of mechanical properties of tissue and biomaterials, cellular interactions with biomaterials, and finite element analysis.
3. Collect, record, process, statistically analyze, and report experimental data related to the analysis of mechanical testing and cellular interactions with biomaterials.
4. Theoretically design a device/and or method to solve a biomechanical or medically relevant problem.

Lab Manual: A Laboratory Introduction to Biomechanics and Biomaterials (PDFs provided on Blackboard)

Supplies: Laboratory Notebook with duplicate pages (required)

Examples:

- Roaring Springs, Edison Lab Notebook # 7097277644
- National Brand, Laboratory Research Notebook # 7333343649

Safety Goggles (required)

Laboratory Attire: Safety regulations require that you wear long pants (or equivalent) and closed-toe shoes while working in the laboratory. ****NOTE: If a student does not come to lab in appropriate attire they will not be allowed to participate in the laboratory exercise and thusly will receive a zero for the laboratory notebook and post-lab assignment.*** **Laboratory coats will be supplied for appropriate wet labs.**

Academic Conduct: Professional and ethical manners are expected at all times. Plagiarism or cheating will not be tolerated and will result in a zero for that particular assignment. Should an individual behave unethically during the semester, the instructor reserves the right to fail the student. For more information, see Purdue University Student Conduct Code at:
http://www.purdue.edu/studentregulations/student_conduct/index.html

Class Attendance: 100% attendance is required to pass. If a class is missed due to extenuating circumstances (i.e., a death in the family), a course instructor should be contacted immediately and written documentation will be required. Make-up work will be considered and assigned on a case-by-case basis.

Campus Emergency Response Procedures:

- Fire Alarm – Evacuate the building using the exits on the south side of RM 1061. Only gather personal items if it does not jeopardize your safety. Assist those who need help, if possible. Proceed to the west side of Lily Hall. Report to a course instructor your name before leaving the emergency assembly area.
- All hazards warning (examples of hazards: tornado (severe weather)/hazardous materials release/civil unrest/directed by police personnel) – When you hear the all hazards alarm immediately seek shelter. Continue to a safe location (typically the lowest level of the building in an area without windows).

Campus Emergency Policy: In the event of a campus wide emergency the class outline and course requirements may be subject to change. The course instructor will provide information in regards to changes in the course requirements or course schedule as a result of a campus wide emergency.

Grading:

Standard Labs	45%
Discovery Learning Laboratories	20%
CAD Project	10%
Term Project	25%
Total	100%

Break down of Standard Labs

Pre-Lab	30%
Notebook	20%
Post-Lab	50%
Total	100%

#Break down of Discovery Learning Labs

Pre-Lab	25%
Notebook	15%
Formal Report	60%
Total	100%

#Break down of Term Project

Milestone 1	5%
Milestone 2	15%
Milestone 3	25%
Milestone 4	40%
Milestone 5	15%
Total	100%

The instructor reserves the right to fail a student on any team assignment in which the student is unable to demonstrate significant contribution to completing the assignment. Team assignments included are discovery learning pre-labs and notebooks, and term project milestones 1, 2, 3, and the poster construction/presentation.

*****In order to receive credit for your term project presentation you must demonstrate completion of the BME 206 end of course evaluations. Students who fail to demonstrate completion of the survey will receive a zero for the assignment. You will be given time during class to complete these evaluations.

Grade Scale: The following grading scale is guaranteed; however, based upon student performance, final grades may be curved by the instructor.

A	94 – 100%	C+	77 – 79%
A -	90 – 93%	C	73 – 76%
B+	87 – 89%	C-	70 – 72%
B	83 – 86%	D+	67 – 69%
B-	80 – 82%	D	63 – 66%
		D-	60 – 62%
		F	<60%

Regrade Policy: Students have the right to contest a grade. In the event an assignment has been graded incorrectly the student must submit a typed page indicating were the problem occurred in the assignment as well as your reasoning for the regrade submission. The original assignment must be returned with the grade disagreement document. Students have 1 week to protest a grade. After this time grade disagreements will not be accepted. Papers submitted for a regrade will be completely reevaluated. This means that additional points may be removed for mistakes missed during the first grading process. Please note that regrade requests will only be evaluated at the end of the term for those students who have a borderline grade (i.e., between an A and B).

Assignment Details. For each lab, you will be required to complete a pre-lab assignment and either a post-lab assignment or a formal lab report. In addition, you are expected to maintain a laboratory notebook throughout the course of the semester. Following is a description of what is expected for each.

Pre-Lab Questions. Each pre-lab assignment is designed to assist you in preparing for the associated laboratory activities. A significant part of the pre-lab assignment involves thoroughly reading over the laboratory exercise (and any supplementary material provided to you). The pre-lab assignments are administered through blackboard learn. Prelab assignments must be completed by the start of your assigned laboratory period. Pre-labs not completed prior to the start of the lab will not receive credit.

Notebook. Notebooks should include the following information: you name, date, partner's name, laboratory title, the objective, observations, and results for each laboratory part (see Figure 1). Data such as calculations and numerical information used or obtained in the experiment must be written down (this includes reagent weights, solution concentrations, dilution calculations, absorbance readings, etc.). Any thoughts or observations about a particular procedure should also be recorded. For instance, if you mix two solutions and a new color results, write down that observation. These observations/thoughts may be important in the post-lab analysis. Finally, any data printouts or computer generated graphs or plots should be taped into the notebook. All entries in the lab notebook are to be done in black ink. If you make a mistake, simply cross out the mistake by making an X through the area and make the correction next to it. It is expected that all work is well organized. An example of a well-kept lab page is provided at the end of the lab guide. A carbon copy of your notebook pages is to be turned into a laboratory instructor at the end of each laboratory session. Figure 1 shows an example of what a notebook should look like.

Notebooks will be graded on a 0 – 3 point scale in which your notebook will be assessed using the scale in Table 1. Failure to turn in a notebook on the due date will result in a 0 for that assignment.

Table 1. Laboratory Notebook Assessment

Score	Assessment
3	All information is included in a clear and complete manner
2	Information is clearly presented in an organized manner, but missing minor information (printout, data, objectives, observations, etc.); Lack of figure and table labels.
1	Information is presented unclearly (information is not organized, lack of use of tables and figures when appropriate) or significant information is missing (missing 2 or more components of the notebook)
0	Notebook was not turned in

BME 205 **Lab No.** 1	**Title:** Fundamental Laboratory Safety and Practices **Date:** 08/ 24/ 2006	
	Name: Josh Sinker ***Group Members:*** Jill Lake , Johann Bach, Sean Carter, Calvin Broadus	***Page No.*** 1

Part #: 1

Objective: Determine the accuracy and precision of a L1000 and L200 micropipette using an analytical balance

Observations: Sometimes the balance would show a weight (~0.005g) after it had been tared.

Results:

Table 1.1: Weight of a specified aliquot of water that from an L1000 or L200 micropipette

Micropipette	Volume (mL)	1st Reading (g)	2nd Reading (g)	3rd Reading (g)
L1000	1.0			
L200	0.2			

Part # 2

Objective: Preformed a 2 point calibration using pH buffers 7.0 and 4.0

Observations: pH meters took a while to record a reading.

Results: A 97% slope was acquired from the 2 point calibration.

Part #3 ……

Josh Sinker 08/ 24/ 2006

Figure 1. Example of a Notebook page for a standard report.

****The term notebook will be graded differently than notebooks associated with the discovery or standard labs. Please see the term project section for more details.***

Post Lab Analysis. For most labs, you will be expected to turn in a post-lab analysis. Post-lab analyses will involve the analysis and interpretation of the data obtained during the laboratory exercises. You will also be expected to answer questions involving application and integration of the relevant concepts covered in that lab. These assignments may be typed or handwritten (as long as you print clearly). The post-lab analysis is to be handed in at the beginning of the following lab period. Each person in the class is to complete and turn in their own post-lab assignment. Post lab analyses are due at the start of laboratory following the course schedule. A 20% grade reduction is imposed per day for late post lab analyses.

Discovery Learning Laboratory Formal Reports. During the semester, you will be expected to complete three formal lab reports associated with the Discovery Learning Laboratories (Labs 3, 6, and 8). These reports are to be completed with your lab partners; each group will turn in one report. The formal lab reports must be typed. All partners are expected to contribute equally to the assignment. Formal Reports are due at the start of laboratory following the course schedule. A 20% grade reduction is imposed per day for late formal reports.

A proper lab report is well thought out and well organized. The lab report will consist of the following components: lab title, brief abstract, introduction, materials and methods, results, discussion and conclusions, and any references.

The title page will include the title of the report, the group members' names, the class number, and the date.

The abstract provides a summary of the entire lab report. It should contain a brief introduction, materials and methods, results, and discussion and conclusions. The abstract should not exceed 250 words. The goal of the abstract is to catch a reader's attention or interest.

The introduction should include background information on, and the rationale for, the problem investigated in the experiment. In some instances, it may be necessary to use information outside of that provided in the lab. In addition, the overall goal of the study should be identified (i.e., what hypothesis is being tested?) and a brief explanation of what you want to accomplish and how you will do this should follow. However, the reader should not be able to read the introduction and know the specific procedures and outcomes of the experiment.

The methods section provides the details of the protocol used in the experiment. Another person with the same background should be able to read through the materials and methods section and repeat your work, but this section is not to be copied directly from the lab manual. Furthermore, this section should only include information relevant to the materials and methods utilized, not results. For instance, if you are reading absorbance values for samples to determine the DNA concentration, you should provide information on how you did this, but do not provide the absorbance readings.

The results section should be a descriptive summary of what you found experimentally. While this section will include things such as pictures, figures, graphs, and tables, these items should be accompanied by explanations that relate the findings to the overall goal of the lab. Any figures, graphs, etc. used in the results must be properly labeled; that is, different samples must be identified, different time points must be noted, specific structures in an image must be identified, etc.

The discussion and conclusion section should provide a brief summary of all results and how they relate to the overall goal of the experiment. To do this properly, you will likely have to refer to the figures and graphs that were generated in the results section; you cannot assume that the reader will just know what you are talking about. In addition, you should discuss the overall significance and relevance of your results in terms of "the big picture".

The reference section is to include any sources used while writing the lab report. This means any information gathered to provide a well-rounded introduction should be cited, etc.

A productive method for working through a lab report is as follows:

1. Write out the Methods.
2. Analyze your data and determine the best format for its presentation; create figures, tables, etc.; write up your Results section.
3. Write an Introduction that provides a relevant "backdrop" for your work.
4. Write a Discussion and Conclusions section that explains the observations/results you obtained during the experiment. Make sure to reiterate the most important findings as well as discuss their relationship to the overall experimental goal and their relevance to BME applications.
5. Write the Abstract, a brief summary of the entire lab.

General Tips on writing an Excellent Formal Lab Report

General –

- Never use "I". Try to avoid statements in which you have to indicate someone doing something. When necessary use "we" instead of "I".
- Figures should have a label, title, and a caption below it.
- Tables should have a label and title above it.
- Tables and figures should always be referenced or referred to in the main body of your paper.
- Labels to figures and tables should always be on the same page as that figure or table.
- Avoid using contractions or symbols in your document as words (i.e., in the text of your document you should not use % or #, write out the word); exceptions include in tables in which you are indicating a unit or when you are listing a specific percentage (i.e., 89%). Then %, in place of "percent" is acceptable.
- When using abbreviations be sure to describe to the reader what the abbreviation is prior to using (i.e., phosphate buffered saline (PBS), fetal bovine serum (FBS), etc.)
- Scientific writing never uses the word "proves" (or any other derivative of that word); there is always room for it to not be true. Use less powerful words such as "the data suggests" or "the data indicates".
- Avoid using a lead in such as, "in part 2 of the lab" or "in the next section of the lab". Just state exactly what you are doing. It will flow just fine without that lead in. Scientific writing is very cut and dry. Get to the point! Avoid losing your readers in "writing fluff".

Abstract –

- Should contain the following:
    - General statement about why you are doing this experiment (global picture)
    - Summary of materials and methods (2-3 sentences)
    - Summary of results (include analyzed data such as statistical differences or measured values). Give a reason for the reader to want to read the rest of the article.
    - Discussion/conclusions. Include specifics as well as global. (i.e., this experiment indicates….which means that….)

Introduction –

- Why are you doing this? What is the big picture?
- Background detail. What is already known? We are not looking for a book. Use the information provided in the background to the lab.
- Summary of what you are going to do to answer the problem that you have posed. No specifics keep! Keep it generalized! I should not know how to do the experiment; I should just know what you did.
- Hypothesis on this experiment. Can be very general.
- Be sure to reference correctly! All information presented that is not common knowledge needs to be referenced (i.e., population statistics, new findings on a disease, unique gene markers, etc.). If you are unsure about referencing contact an instructor. Referencing should be in IEEE format. If you do not know what that is go and look it up.

Methods –

- Should not be written as directions.
- Can be helpful to break it into subsections (i.e., Lab 3: Protein Analysis):
    - Protein gel
    - BCA Assay
- If you happen to complete statistical analysis for data analysis you may create a separate statistics section in which you would list what type of test was done (including post hoc) and the significance level that you choose as a cut off (Typically $p \leq 0.05$). If a software statistical analysis program was used that should be mentioned as well (SAS, SPSS, NCSS, MiniTab, etc.).

Results –

- Organize your data. Use tables and graphs to emphasize the results.
- Every table or figure needs to have supporting text in the main body of the results section. Supporting text can be used to describe the figure or use the figure to help clarify your text.
- Conclusions that you draw from the results should never be presented in the results section.
- Raw data should not be presented. For example, absorbance readings and step by step calculations from standard equations are considered raw data.
- Observations should be included in the results section.
- How to present statistical information:
    - Data suggests there is a significant difference between group A and B ($p \leq 0.05$).
    - There is no statistical difference between groups A and B.

Discussion & Conclusions –

- Big opening sentence or two discussing the importance of this project (lab).
- Summary of all results. Good time to reiterate significant differences between test groups.
- Discuss your interpretations of the results (goes hand in hand with summary of results. Two sections should be interwoven). What does the data mean? Yes it is significantly different but is that good, bad, does it really matter?
- Big closing. What can come from your results? What is the next step in understanding/solving the problem?

CAD Project: You will be working on this project individually or with a partner of your choosing. The goal of this project is for you to master the basics of CAD. You will design a 3-D model of a biomedical device that will be rapid prototyped using a 3-D printer. You will then evaluate your prototype for relevant functional properties. Lastly, you will communicate the design process and outcomes through a written report.

Term Project: Throughout the semester you will be working with a team to evaluate the material properties of a biomaterial that can be used to solve a clinical problem. During the first class session you will be introduced to the project and your team. Milestone assignments are due at the start of laboratory following the course schedule. A 20% grade reduction is imposed per day for late milestones. Refer to your Design Project section for additional details regarding the assignments.

Week	Week of	Lab Activity	Assignment Due
1	1/13	**Lab 1:** Introduction to Cell Culture and ANOVA Statistics	Pre-lab 1
2	1/20		***Milestone 1: Identification of Investigation***
3	1/27	**Lab 2:** Cytotoxicity of Biomaterials	Pre-lab 2, NB 1, and Post-lab 1
4	2/03		
5	2/10	**Lab 3:** Macrophage response to Biomaterials	Pre-lab 3, NB 2, and Post-lab 2
6	2/17		***Milestone 2: Clinical problem summary***
7	2/24	**Lab 4:** Biomaterial and Protein Interactions	Pre-lab 4, NB 3, Lab 3 Formal Report
8	3/02	**Lab 5:** Vector Principles Applied to the Human Body	Pre-lab 5, NB 4, Post-lab 4,
9	3/09	**Lab 6**: Biomechanics of the rat	Pre-lab 6, NB 5 and Post-lab 5
10	3/16	*Spring Break*	
11	3/23	**Lab 7:** Tension and Compression testing of biomaterials and rat tissues	Pre-lab 7, NB 6, Lab 6 Formal Report
12	3/30	**Lab 8:** Fatigue of Biomaterials and Bone using 3 and 4 Point Bending	Pre-lab 8, NB 7, and Post-lab 7
13	4/06	Term Project – Experimental Design	NB 8 and Lab 8 Formal Report
14	4/13	Term Project – Material Testing Laboratory & Data Analysis	***Milestone 3: Project Outline***
15	4/20	Term Project – Material Testing Laboratory & Data Analysis	
16	4/27	Poster Preparation (**Milestone 5: Poster Preparation**)	***Milestone 4: Design Notebook is due at the conclusion of class; Poster due date TBA***
17	5/04	Finals week – Poster presentations (**Milestone 5: Poster Presentation**)	***Date to be decided, Please check with Instructor***

BME 295 BIOMECHANICS AND BIOMATERIALS LABORATORY
SYLLABUS
Spring 2021

Lab Coordinator: Michael Linnes — Office: MJIS 1055
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Teaching Assistants (TAs): Chenwei Duan
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Other Course Contacts: Sherry Harbin (Professor; Instructor of Record) — Office: MJIS 3033
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Daniela Nkama (Associate Lab Coordinator) — Office: MJIS 1055
Email: dnkama@purdue.edu

Asem Aboelzahab — Office: MJIS 1084
(Lead Instructional Labs Coordinator)
Email: aboelzahab@purdue.edu

COURSE INFORMATION:

Class Format: Flexible 8-week module format supporting either in-laboratory or remote (online) offerings. Students work as small groups or individually to complete and submit assignments by scheduled due dates

Office Hours: TAs and/or laboratory coordinator will provide hours, location, and/or instructions on how to connect in person and remotely on BrightSpace. **Important Note:** Please be mindful and respectful of teaching assistant and instructor time, making every effort to best use laboratory time and office hours for course related questions and concerns. Course related issues that arise outside of office hours can be communicated individually or collaboratively via direct email contact.

Pre-requisites (may be taken concurrently):
BIOL 230 Biology of the Living Cell

Course Description: Introductory undergraduate laboratory module (8 weeks; 1 credit) focused on engineering concepts and practices relevant to material biocompatibility and mechanical performance testing within the context of rapid prototyping and medical device development. Topics and activities focus on defining fundamental attributes and processes associated with material-cell and material-tissue interactions through use of biomechanical analyses, in-vitro cell culture, relevant regulatory guidance documents, voluntary consensus standards, experimental design, finite element analysis, statistical analysis and interpretation of results. At the conclusion of this module, students will present a prototype or finite element simulation of their medical device design together with a detailed biocompatibility and biomechanical analysis relevant to its application.

Learning Outcomes:
Upon completion of the course each student will be able to:

1. Describe the importance of regulatory guidance documents and voluntary consensus standards as they relate to the design, development, and testing of new therapeutic and diagnostic devices.
2. Implement the experimental design process, including proper maintenance of a design laboratory notebook and use of appropriate statistical analysis methods, as it applies to biocompatibility and mechanical performance of materials used for medical device design.
3. Independently employ fundamental tools, testing procedures, and analyses relevant to computer-assisted design (CAD), in-vitro cell culture, and biomechanics, for rapid prototype development, analysis of mechanical properties of tissues, materials, and devices, and defining biocompatibility of materials and devices.

Lab Manual and Other Instructional Materials:
All instructional materials will be available through Brightspace (https://purdue.brightspace.com). All assignments will be collected via Gradescope unless otherwise indicated.

- A Laboratory Introduction to Biomechanics and Biomaterials
- Instructional online videos that provide topic overview and associated instructions for completion of laboratory and Design Project activities within in-laboratory or remote settings.
- Video demonstrations of conventional tools, testing instrumentation, and/or procedures used for computer-assisted design (and finite element simulations), in-vitro cell culture, and biomechanical performance testing. Videos will highlight key procedural aspects and common problems to avoid.
- Example datasets with and without example analyses.
- Other supporting documents and/or information

Supplies:

- Face Mask
- Face Shield
- Safety Goggles (when indicated)
- Writing Utensil
- Electronic notebook (via Microsoft Word or similar)

Laboratory Attire: Safety regulations require that you wear long pants (or equivalent) and closed-toe shoes while working in the laboratory. Laboratory coats will be supplied when necessary. NOTE: Those students not wearing appropriate attire will not be allowed to participate in the laboratory activity and will receive a zero for associated assignments.

OVERALL EXPECTATIONS:

Academic Conduct: Professional and ethical behavior is expected at all times. Students are expected to contribute to a positive learning environment, showing respect to course instructors and their peers. Plagiarism or cheating will not be tolerated and will result in a zero for that particular assignment. The instructor reserves the right to assign a zero grade to a student on any team assignment in which the student is unable to demonstrate significant contribution to completing the assignment. In the situation that a student behaves unethically during the semester, the instructor reserves the right to fail the student.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered.

For more information, see Purdue University Student Conduct Code at:
http://www.purdue.edu/studentregulations/student_conduct/index.html

Classroom Guidance Regarding Protect Purdue: The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask in classrooms and campus building, at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

Nondiscrimination Statement: Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. More details are available on our course Brightspace table of contents, under University Policies.

Accessibility: Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

EXPECTATIONS FOR THE LABORATORY:

Class Attendance and Participation: Students should make every attempt to fully participate in the course and complete all activities and assignments. Under normal circumstances 100% attendance is required to pass. For this offering, we are operating under modified circumstances owing to the COVID-19 pandemic. If your participation is compromised due to extenuating circumstances (i.e., a death in the family, difficulties with remote access and connection, COVID-19), a course instructor should be contacted immediately. Relevant written documentation may be required. Make-up work will be considered and assigned on a case-by-case basis. *To receive credit for the lab, a student must be in the lab on time, no more than 15 minutes late. A student who is more than 15 minutes late and who does not have an excused reason may receive a zero on the lab.*

Attendance Policy during COVID-19: Students should stay home and contact the Protect Purdue Health Center (496-INFO) if they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, but the student still needs to inform the instructor of any conflict that can be anticipated and will affect the submission of an assignment or the ability to take an exam. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible.

For unanticipated or emergency conflict, when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, through Brightspace, or by phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Academic Guidance in the Event a Student is Quarantined/Isolated: If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur.

Lab Safety: See the lab safety document posted on Brightspace. It provides some general safety precautions and guidelines that apply to all laboratory activities associated with this course. In addition, each lab will spell out specific safety issues that apply to that week's lab activities. For more complete information on laboratory safety items, you may also contact a lab instructor, or call REM directly (4C0121). REM is the Radiological and Environmental Management agency on Purdue's campus; they oversee lab safety practices on campus.

EMERGENCY POLICY/PROCEDURES:

Campus Emergency Policy: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Laboratory Emergency Response Procedures (applicable for in-laboratory offerings only):

- **Fire Alarm** – Evacuate MJIS 1061 through the south door (nearest the elevator); then, leave the building through the doors which exit to the east side of the building (back of the building near the construction of the Herrick Labs extension). Only gather personal items if it does not jeopardize your safety. Assist those who need help. Proceed to the front lawn Lilly Hall of Life Sciences (corner of State St. and S. Russell Dr.) **Report to a course instructor your name before leaving the emergency assembly area.**
- **All Hazards Warning** (Tornado, hazardous release, civil unrest, etc.) – When you hear the all hazards alarm immediately seek shelter (**Shelter-In-Place**) in a safe location. For a tornado, proceed to the basement of MJIS, using either the stairwell on the northwest side (by the police station) or the southeast side (across from MJIS 1087).

GRADED COURSE MATERIAL:

Course Schedule and Due Dates: A detailed schedule of weekly laboratory topics, PreLab assignments (e.g., reading materials, lecture videos, video tutorials, quizzes), PostLab assignments, design project milestones, and due dates are available on BrightSpace. Unless otherwise specified, all assignments should be submitted through Gradescope.

Best Practices for Completing Team-Based Assignments: The majority of assignments for this course will be completed with students working as part of a team, with each student being evaluated based on their ability to work and communicate as a team. Effective team work requires effective communication amongst group members. Each team member, whether operating in person or remotely, needs to take responsibility for respectfully communicating their thoughts and ideas as well as listening to those of others. All team members are expected to contribute equally and fully toward completion of each assignment. For this reason, it is important

to set work expectations and timelines so that each member can plan, manage their time, and act accordingly. Also, remember each team member brings different strengths and weaknesses, so take this into account when assigning individual tasks. In situations where team members are not participating as expected, please Contact your section TA and the Laboratory Coordinator immediately.

PreLab Quizzes & Online Material: It is expected and required that students perform the PreLab assignment individually prior to coming to lab each week. This involves reading and understanding the laboratory procedure, watching online lecture videos and instructional videos. Each weekly PreLab assignment can be found in the laboratory manual and all lecture and instructional videos are available through BrightSpace. PreLab activities include individual completion of short PreLab quizzes administered via Gradescope that test your retention of PreLab material.

PostLab Assignment Submissions: Each weekly PostLab assignment can be found in the laboratory manual. Weekly PostLab questions, problems, and data analysis are highlighted in red throughout the laboratory manual. All requested information should be provided within the designated sections of the PostLab Appendix and submitted as a team via Gradescope by the designated due date.

Integrated Design Project and Milestone Submissions: In this course you will have the opportunity to apply what you learn in weekly laboratories to the early-stage engineering design of a medical device that employs rapid prototyping (3D printing, otherwise known as additive manufacturing). This includes maintenance of an electronic design laboratory notebook (see Appendix A of Design Project), information gathering, problem definition, idea generation, evaluation and decision making, and creation of a final video presentation. Each week, there is a design project milestone that must be completed and submitted as a team via Gradescope by the designated due date. Refer to the Design Project document on Brightspace for specific details on Milestones. Milestone due dates are summarized in the Course Schedule.

Laboratory Practical: Students will individually complete a laboratory practical that will be administered during the module. This performance exam will evaluate a student's ability to practice essential skills and techniques learned throughout the course. Specific skills that may be included as part of the laboratory practical include:

- Accurately transfer a volume of fluid using an appropriately selected micropipette under aseptic and/or non-aseptic conditions
- Accurately transfer a volume of fluid using an appropriately selected serological pipette under aseptic and/or non-aseptic conditions
- Calculate and create dilution curves, with spectrophotometric validation
- Calculate and create a cell suspension at a specified cell density
- Perform a hemocytometer count to accurate determine the density (cells/mL) of a cell suspension
- Describe the fundamental reagents and process used when passaging adherent and suspension cells
- Describe best practices associated with mechanical testing along, including management of common pitfalls
- Perform a mechanical test on a material using specified testing parameters, including data transfer, data analysis (e.g., stress and strain calculation), and proper display of data in graphical form
- Describe fundamental differences between standard elastic and viscoelastic materials and the types of tests used to evaluate viscoelastic materials.
- Evaluate test data and identify and perform an appropriate statistical test

Late Submissions: No late PreLab quiz submissions will be accepted. Late laboratory submissions and design project submissions will lose 25%/day including weekend days. Late work should be submitted to Gradescope or emailed directly to the Lab Coordinator.

Online Course Evaluations: Online course evaluations for this class are considered assignments, which must be completed to full point credit. You are asked to submit to the lab coordinator evidence of evaluation/survey completion prior to the associated due date. If no evidence of evaluation/survey completion is submitted you will receive a zero for the assignment.

COURSE GRADING:

The following grading scale is a guaranteed minimum; however, based upon student performance, final grades

may be curved by the instructor.*

Letter Grade	Percentage	GPA score
A+	≥ 98	4.0
A	≥ 93	4.0
A-	≥ 90	3.7
B+	≥ 87	3.3
B	≥ 83	3.0
B-	≥ 80	2.7
C+	≥ 77	2.3
C	≥ 73	2.0
C-	≥ 70	1.7
D+	≥ 67	1.3
D	≥ 63	1.0
D-	≥ 60	0.7
F	<59	0

Grade Breakdown:

PreLab Quiz x 5	15 %
PostLab Submission x 5	30 %
Design Project Milestones, Design Notebook, and Video Presentation	35 %
Individual Laboratory Practical	10%
Individual Participation, Rigor, and Team Assessment	10 %*

***** If you do not complete the course evaluation you will not receive a grade for individual participation and rigor.

Re-grade Policy: Students have the right to contest any grade throughout the semester as long as a member of the team has made an effort to attend office hours for that graded assignment. Once an assignment has been graded and returned, students have **1 week** to protest a grade via Gradescope; after this time grade disputes will not be accepted.

BME 295 Biomechanics and Biomaterials Laboratory

Laboratory and Design Project Schedule

Second 8-Week Module

	Lab Topic	PreLab Assignment	PostLab Assignment	Design Project Assignment
Week 1 March 15-19	Lab 1: Vector Principles and Static Biomechanics	Monday, March 15	Friday, March 26	Milestone 1: Friday, March 26
Week 2 March 22-26	Lab 2: Tensile Testing and Stress-Strain Curves	Sunday, March 21	Friday, April 2	Milestone 2: Friday, April 2
Week 3 March 29 – April 2	Lab 3: Compression Testing	Sunday, March 28	Friday, April 9	Milestone 3: Friday, April 9
Week 4 April 5 - 9	Lab 4: Cell Culture and In-Vitro Cytotoxicity	Sunday, April 4	Friday, April 16	Milestone 4: Friday, April 16
Week 5 April 12 - 16	Lab 5: Viscoelastic Behavior of Tissues and Biomaterials	Sunday, April 11	Friday, April 23	Milestone 5: Friday, April 23
Week 6 April 19 - 23	In-person lab - Design Project: In-Vitro Cytotoxicity Testing Study	no prelab	none	Include in final milestone
Week 7 April 26 - 30	In-person lab - Design Project: Mechanical Performance Testing Study	no prelab	none	Include in final milestone
Week 8 May 3 - 7	Design Project Notebook and Poster Video Finalization	no prelab	none	Milestone 6: May 7