None of the artifacts were collected from the Madrid campus, or other off-campus locations. Several courses were delivered in an online / hybrid format (BME 4400, BME 4430).

For AY 2021 was the data upon which this report is based colle[illegible] 2.8 (4 a0su4081.8 (l)-0Y8 (t)1..6 (8fEMC /P 8f(a)-2.8>BDC 33(8f1 Tw 18 8 -0
courses: BME 3100, BME 4400, BME 4410, BME 3840, BME 4130, BME 4200, and BME 4430

Biomedical Engineering
ABET Assessments Fall 2020
Form 3.5 Evaluations

Methods: 1,2

- Homework, quizzes, and exams – solving an array of engineering problems related to continuous time and discrete signal characterization and signal processing.
  Assessment Outcome - Exam 2 – 43/47 >70%: Level A
  Assessment Outcome - Exam 3 – 43/47 >70%: Level A

- Computer assignments and projects – completing several MATLAB based signal processing assignments, for example, frequency analysis of audio signals and digital signal filtering.
  Assessment Outcome – Matlab 3: Filter Implementation – 46/47 >70%: Level A
  Assessment Outcome – Matlab 6: Audio FFT – 44/47 >70%: Level A

(l): This course contributes to our students' understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.
Methods: 2

- Computer assignments and projects – y enenen( ) T0.2Tf(w) as aef(s)-1 (s)-1 (i)-2 (ng (s)-d. 1 Tf0

BME Form 3.5 Faculty Course Evaluation

Course Number: **BME 4400**
Course Title: **Biomaterials**
Semester: **Fall 2020**
Instructor: **Silviya Zustiak**
Date : 1/19/21 **Department Review Date:**

Course Grade Distribution

Grade	F	D	C-	C	C+	B-	B	B+	A-	A
Number of Students	0	0	1	1	1	2	7	9	16	10

Assessment of Student Outcomes
For each student outcome indicate the *Phase-I* assessment methods (1-7) used or NA if the outcome is not reflected in this particular course. For each method listed please provide a more specific description of the assessment method, rank the achievement level, and provide quantitative evidence to support the achievement level.

(b): The course contributed to your ability to design and conduct experiments, as well as to analyze and interpret data.
Methods: 1:

- Homework #1 – students were given a real data set and tasked with building a stress-strain curve and determining several materials properties: 94%; 47/47 > 70% (Level A)
- Exam #1 – students had to interpret data from recent relevant research papers: 83.4%; 43/47 >70% (Level A)
- Quizzes (average of 9 assignments + 2 practice ungraded assignments) – students were often given data from current literature and asked to explain why a certain phenomenon was observed: 81.3%; 44/47 >70% (Level A)

(e): This course contributes to our students' ability to identify, formulate, and solve engineering problems.
Methods: 1, 2, and 5

- Homework #2 – The students were tasked with solving problems related to polymers. They were given structures of polymers/materials un-known to them and asked to identify properties based on known common principles and concepts: 93.2%, 47/47 > 70%; (Level A)
- Group project on device development: 96.9%; 47/47 > 70% (Level A)

(i): This course contributed to your recognition of the need for, and an ability to, engage in life-long learning.
Methods: 4 and 5

- Group Project – The project included 3 phases where the students had to submit 3 written project reports (1 – Background; 2 – Proposed Design and Rationale;

and 3 – Cost and Targeted Market): 96.9%; 47/47 > 70% (Level A)

- Homework #3 – The students were supposed to work with their group and prepare a written 3-6 page report and a short presentation (3 min elevator pitch) to educate the class on a specific class of biomaterials not covered in lectures (e.g. pyrolytic carbon). The presentations were conducted as an in-class activity, where students were separated into groups of "presenters", "judges", "audience charged with asking questions". An "award of 5 bonus points" was given to the best presentations – 99.5%; 47/47 >70% (Level A)

(k): This course contributed to your ability to use techniques, skills, and modern engineering tools needed for engineering practices.

Methods: 1 and 2

- Exams, homework, and quizzes – the students were examined or quizzed on the material learned in class, which covered novel materials, current technology, and current challenges in the field.
  - Homework assignments (3 assignments): 95.6%; 47/47 > 70% (Level A)
  - Exams (3 assignments): 86.7%; 46/47 >70% (Level A)
  - Quizzes (9 graded assignments): 81.3%; 44/47 >70% (Level A)

(l): This course contributed to your understanding of biology and physiology, and the capability to apply advanced mathematics (includes differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.

Methods: 1 and 2

- Exams, homework, and quizzes – the students were examined or quizzed on the material learned in class, which routinely covered host-material interactions.
  - Homework assignments (3 assignments): 95.6%; 47/47 > 70% (Level A)
  - Exams (3 assignments): 86.7%; 46/47 >70% (Level A)
  - Quizzes (9 graded assignments): 81.3%; 44/47 >70% (Level A)
- Group Project: The students were supposed to design a biomedical device while focusing on the biomaterial aspect (e.g. islet encapsulation). They had to take specific host-material interaction into consideration in their design (e.g. Would you expect cell infiltration? What would the consequences be? Would you expect systemic toxicity and/or hypersensitivity and why or why not?)
  - The project included 3 phases where the students had to submit 3 written project reports (1 – Background; 2 – Proposed Design and Rationale; and 3 – Cost and Targeted Market): 96.9%; 47/47 > 70% (Level A)

(m): This course contributed to your ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

Methods: 1 and 2

- Exams, homework, and quizzes – the students were examined or quizzed on the material learned in class, which routinely covered host-material interactions.
  - Homework assignments (3 assignments): 95.6%; 47/47 > 70% (Level A)

- Exams (3 assignments): 86.

- Identify design criteria for biomaterials for a specific application.
- Identify design criteria to improve biocompatibility of biomaterials for specific applications.
- Explain potential problems associated with a specific biomaterial implantation.
- List main reasons for implant and biomaterial failure and devise possible solutions to address these problems.

The objectives of this course were met as 47 out of 47 students demonstrated good knowledge and showed much interest in the material. The students regularly participated in discussions via Zoom polling and chat features and whole class activities. I also implemented some group quizzes where two students had to discuss and agree on their answers. The students appreciated this format as it helped them think about the material and remember it better. Students were given additional practice quizzes and homework to practice applying concepts they learned in class, to solving biomaterial problems. Overall, the students complained that the quizzes were hard, that there was a large amount of reading, and that they wanted more practice material that would not be graded. I routinely self-evaluate and poll students to get timely feedback during the semester. As a response to students requests, I have scaled back on the reading materials since my first year teaching the class and have given then an additional ungraded homework prior to exam 3 and 1 un-graded quiz each prior to Exam 2 and 3. I also routinely polish both my quizzes and the lecture material to address concepts that students seem to struggle with. Students also appreciated the continuous feedback on their project and the multiple reports format. The students also liked learning about a new material on their own and were eager to share what they learned with their peers. Lastly, I encourage the students to attend 2 BME seminars a semester, for which I give them modest extra credit. The students appreciate hearing from experts in their field.

BME Form 3.5 Faculty Course Evaluation

Course Number: BME4410
Course Title: Tissue Engineering
Semester: Fall 2020
Instructor: Dr. Sell
Date: 06/29/21 **Department Review Date:** _____

Course Grade Distribution

Grade	F	D	C-	C	C+	B-	B	B+	A-	A
Number of Students	0	0	0	0	0	0	0	1	5	34

Assessment of Student Outcomes
For each student outcome indicate the *Phase-I* assessment methods (1-7) used or NA if the outcome is not reflected in this particular course. For each method listed please provide a more specific description of the assessment method, rank the achievement level, and provide quantitative evidence to support the achievement level.

(b): This course contributes to our students' ability to design and conduct experiments, as well as to analyze and interpret data.
Methods: 3, 4, 5, 6, 7

The course is run as a semester long group project to simulate a tissue engineering startup company. One of the 3 major components of this project is to determine and develop a testing regime for a tissue engineered product. Students work as groups to review literature on a specific tissue and they formulate a testing regime for that tissue. They then present their testing regime to the class as an oral presentation and provide a written document to the instructor. The class provides critical reviews and discussion on the chosen testing methods.

Testing Regime Video Average: 94%; 40/40 > 70% (Level A)
Testing Regime Written Paper Average: 92%; 40/40 > 70% (Level A)

(e): This course contributes to our students' ability to identify, formulate, and solve engineering problems.
Methods: 1, 5, 6, 7

An example of this outcome being assessed is through an investigation into appropriate tissue engineering scaffold fabrication techniques. Student groups were presented with the problem of "How would you design a scaffold appropriate for your tissue?" Various engineering techniques were discussed in class lectures, which students were quizzed on. The students then had to think as a group in class, and perform a literature review, about which scaffold fabrication techniques would be appropriate for their specific tissues;

identifying what sort of properties would be important for their tissue (i.e. mechanical strength, degradation rate, porosity, viscoelasticity, etc.), formulating a plan for creating an ideal scaffold, and then providing a written report that included the rationale (using the key engineering parameters discussed in class) for two techniques that would be appropriate and two techniques that would not be appropriate for use. Similar approaches were utilized for the design of an appropriate bioreactor system.

Final Design Video Average: 95%; 40/40 > 70% (Level A)
Final Design Written Paper Average: 91%; 40/40

(l): This course contributes to our students' understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.
Methods: 1, 3, 4, 5, 6, 7

While much of the student work performed throughout the semester focuses on engineering and design, many of the lectures provided (especially during the first half of the semester) focus on the biology and physiology background needed to be a successful tissue engineering (i.e. cell biology, biochemistry, stem cell biology, extracellular matrix physiology, etc.). The students then pull these concepts together through their semester long project. They are required to determine the key components of their tissue's unique physiology that make it a challenge to engineer as they begin work on their novel product design.

Final Design Video Average: 95%; 40/40 > 70% (Level A)
Final Design Written Paper Average: 91%; 40/40 > 70% (Level A)
Quiz Average (9 Quizzes): 94%; 40/40 > 70% (Level A)

(m): This course contributes to our students' ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.
Methods: 3, 4, 5, 6, 7

See description for (b) above. Students must perform a literature review to develop a testing regime for their native tissue. This is then expanded upon in the final component of the semester long project, where students must address implementation and success. They have to formulate a method for determining whether their novel product has been successful (i.e. appropriate testing outcomes from animal models, translational outcomes, etc.).

Testing Regime Video Average: 94%; 40/40 > 70% (Level A)
Testing Regime Written Paper Average: 92%; 40/40 > 70% (Level A)
Final Design Video Average: 95%; 40/40 > 70% (Level A)
Final Design Written Paper Average: 91%; 40/40 > 70% (Level A)

Table F3.5-1: Summary of Student and Faculty E8(nt)7 (a)4 (nd F)5 (a)4 (c)7.95 3BDC -3 -1.1q-2 (40)-6 (3

e	**A**	**A**

Biomedical Engineering
ABET Assessments Spring 2021
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BME Form 3.5 Faculty Course Evaluation
Course Number: **BME3840**
Course Title: **Junior Lab**
Semester: **Spring 2021**
Instructor: **Dr.Cooperstein**
Date: **07/08/2021** **Department Review Date:** _____

Course Grade Distribution

Grade	F	D	C-	C	C+	B-	B	B+	A-	A
Number of Students	0	0	0	1	0	0	4	2	6	35

Assessment of Program Outcomes
For each program outcome indicate the *Phase-I* assessment methods (1-7) used or NA if the outcome is not reflected in this particular course. For each method listed please provide a more specific description of the assessment method, rank the achievement level, and provide quantitative evidence to support the achievement level.

(a): This course contributes to our students' ability to apply knowledge of mathematics, science, and engineering.
Methods: (1, 3, 5, 7) Students had to use their knowledge of mathematics, science and engineering to complete pre-lab exercises, prepare themselves for and complete the laboratory experiments, as well as analyze and compile written reports.
- Pre-lab average: 88.7%; 48/48 >70% (Level A)
- Written reports average: 92.6%; 48/48 > 70% (Level A)

(b): This course contributes to our students' ability to design and conduct experiments, as well as to analyze and interpret data.
Methods: (2, 3, 5, 7) Students had to prepare themselves for the experiment by writing detailed experimental protocols for each experiment; they had to perform the experiments and troubleshoot any issues when necessary; as well as obtain data using the provided equipment/software, and analyze that data
- Pre-lab average: 88.7%; 48/48 >70% (Level A)
- Lab work: 100%, 48/48 >70% (Level A)
- Written reports average: 92.6%; 48/48 > 70% (Level A)

(e): This course contributes to our students' ability to identify, formulate, and solve engineering problems.
Methods: (2, 3, 5, 7) Students had to identify, formulate, and solve engineering problems in their pre-labs as well as while performing their experiments
- Pre-lab average: 88.7%; 48/48 >70% (Level A)
- Lab work: 100%, 48/48 >70% (Level A)

(l):

Course Grade Distribution

Grade	F	D	C-	C	C+	B-	B	B+	A-	A

(e): This course contributes to our students' ability to identify, formulate, and solve engineering problems.
Methods: 1, 2

- Homework assignments & exams – solving engineering problems related to the mathematics, physics and engineering of medical imaging systems.
  Assessment Outcome - Exam 1 – 23/26 >70%: Level A
  Assessment Outcome - Exam 3 – 22/26 >70%: Level A

- Computer assignments - MATLAB based assignments including determining the spatial resolution of a cell phone camera and the computing the radon transform.
  Assessment Outcome – HW 1 - Spatial Resolution – 19/26 >70%: Level B
  Assessment Outcome – HW 5 - Radon Transform – 23/25 >70%: Level A

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(k): This course contributes to our students' ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Methods: 2

- Computer assignments - MATLAB based assignments including medical image analysis and processing a simulated ultrasound signal return.
  Assessment Outcome – HW 6 – Medical Image Analysis – 23/25 >70%: Level A
  Assessment Outcome – HW 8 - Ultrasound Signal Proc. – 20/24 >70%: Level A

(l): This course contributes to our students' understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.
Methods: 1, 2

- Homework assignments & exams – solving engineering problems related to the mathematics, physics and engineering of medical imaging systems. A significant amount of the lecture material dealt with how imaging systems interact with tissues, including the x-ray linear attenuation coefficient, acoustic impedance and the principles nuclear magnetic resonance.
  Assessment Outcome - Exam 1 – 23/26 >70%: Level A
  Assessment Outcome - Exam 3 – 22/26 >70%: Level A

- Computer assignments and projects- MATLAB based assignments including computing the radon transform (used in CT imaging) and processing simulated ultrasound signal returns.
  Assessment Outcome – HW 5 - Radon Transform – 23/25 >70%: Level A
  Assessment Outcome – HW 8 - Ultrasound Signal Proc. – 20/24 >70%: Level A

(m): This course contributes to our students' ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.
Methods: 1, 2

- Homework assignments & exams – solving engineering problems related to the

BME Form 3.5 Faculty Course Evaluation

Course Number: BME 4200
Course Title: Biomechanics
Semester: Spring 2021
Instructor: Dr. Cooperstein

(i): This course contributes to our students' recognition of the need for, and an ability to engage in life-long learning.

Methods: (1, 2, 4, 5, 7) In this course students were able to use the knowledge from their other classes to solve problems, complete reading assignments, homework assignments, and projects. Through these assignments, they were introduced to new techniques and new knowledge. They had to use external resources to complete most of the assignments, and develop valuable skills, such as performing literature search or critiquing/analyzing research articles.

- Group project 1 average: 93.7%; 37/37 > 70% (Level A)
- Individual project 2 average: 96.8%; 37/37 >70% (Level A)
- Reading assignments average: 85.3%, 36/37 > 70% (Level A)

(k): This course contributes to our students' ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Methods: (1, 4, 5, 7) The students had to use different types of resources to complete this class. They obtained the required knowledge form textbooks, journal articles, videos; they gave oral presentations using software like PowerPoint or Prezi, working together and individually. They we, [ac5.72 - .004 Tc 0.3448[0 Tw B84 (qui)-2 (r Td(()v1o67 93.04

as well as in Group Project 3, which involved finding a peer -reviewed research article in the assigned field of biomechanics, analyze and interpret the presented data, and determine the study strengths and weaknesses.

- Homework average: 84.9%, 34/37 > 70% (Level A)
- In-class activities average: 97.6%, 35/37 > 70% (Level A)
- Group project 3 average: 98.7%; 37/37 > 70% (Level A)

Table F3.5-1: Summary of Student and Faculty Evaluation
Summarize the phase-1 measures and, based on that data, determine the overall level of achievement. Discuss the basis for that determination in the faculty assessment section below. Please also provide your overall class assessment and, if necessary, an action plan to address concerns.

BME 4200	Student (N/A)				Faculty	
Outcome	**Average (1-5)**	**%A or SA**	**%NA**	**Level**	**Phase-1 Level**	**Overall Level**
b					**A**	**A**
e					**A**	**A**
i					**A**	**A**
k					**A**	**A**
l					**A**	**A**
m					**A**	**A**

Faculty Assessment: In this course students actively participate in in-class activities every class meeting. They are required to come prepared for each class, and they put a lot of effort in all of the assignments employed in this course (homework assignments, reading assignments, individual and group presentations, individual and group written reports etc.). I believe that the students achieved all six outcomes for this course at high level. I continue on introducing new material, focusing on the newest developments in the field of biomechanics and develop new activities that engage the students and expose them to the field.

BME Form 3.5 Faculty Course Evaluation

Course Number: BME4430
Course Title: Regenerative Engineering
Semester: Spring 2021
Instructor: Koyal Garg
Date : 06/15/2021 Degree: Graduate

	F	D	C-	C	C+	B-	B	B+	A-	A
Number of Students								2	4	10

Assessment of Student Outcomes

For each student outcome indicate the *Phase-I* assessment methods (1-7) used or NA if the specific student outcome is not addressed in the assessment course. For each method used please provide quantitative evidence to support the achievement level.

(a) This course contributes to our students' ability to apply knowledge of mathematics, science, and engineering.

Methods: 1, 2, 5, 4, 6

This course discusses the development, applications, challenges, and techniques for improvement of stem cell therapies. We discuss the application of biomaterials, mechanical and electrical stimulation in conjunction with stem cell therapeutics.

- Homework 1 and 2 (Level A)
- Exams (Level A)
- Class Activities (Level A)
- Article Presentation (Level A)
- Final Project (Level A)

(b)

(j) This course contributes to our students' understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.

Methods: 1, 3, 4, 6

We discuss the application of technologies such as biomaterials, mechanical and electrical stimulation to improve the efficacy of cell-based therapeutics. We also take a quantitative approach to understand the mechanobiology of stem cells.

- Homework (Level A)
- Exams (Level A)
- Class Activities (Level A)
- Article Presentation (Level A)
- Final Project (Level A)

(k) This course contributes to our students' ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

Methods: 3, 4, 5, 6

Students interpret data from peer-reviewed journal articles and also collect data/information associated with stem cell properties, tissue composition, and medical conditions for a particular application.

- Class Activities (Level A)
- Article Presentation (Level A)
- Final Project (Level A)

Table F3.51: Summary of Student and Faculty Evaluation

Summarize the phase-1 measures and, based on that data, determine the overall level of achievement. Discuss the basis for that determination in the faculty assessment section below. Please also provide your overall class assessment and, if necessary, an action plan to address concerns.

Student (

Faculty Assessment: