Name of Course: Introduction to Bioengineering

Instructor Name: Caitlin Burke Laurence, Ph.D.

Credits: 3

Office location: Nguyen Engineering Building, Room 3913

Office hours: By Appointment (email me to set up an in-person appt. or to speak over the telephone)

Email address: cburke9@gmu.edu

Telephone number: 703.405.6188

Required Textbooks:


Hardware:

You will need access to a Windows or Macintosh computer with at least 2 GB of RAM and to a fast and reliable broadband internet connection (e.g., cable, DSL). A larger screen is recommended for better visibility of course material. You will need speakers or headphones to hear recorded content and a headset with a microphone is recommended for the best experience. For the amount of Hard Disk Space required to take a distance education course consider and allow for:

1. the storage amount needed to install any additional software and

2. space to store work that you will do for the course.

If you are considering the purchase of a new computer, please go to http://compstore.gmu.edu/pdfs/TechGuide.pdf to see recommendations.
**Software:**

This course will use Blackboard as the learning management system. You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the myMason Portal. See [supported browsers and operating systems](http://support.apple.com/kb/VI54?viewlocale=en_US) for a list of compatible or certified browsers and operating systems. Log in to [myMason](http://mymason.gmu.edu) to access BENG 101. You will need Acrobat Reader, Flash, Java (Windows), and Windows Media Player, QuickTime and/or Real Media Player. Your computer should be capable of running current versions of those applications. Also, make sure your computer is protected from viruses by downloading the latest version of Symantec Endpoint Protection/Anti-Virus software for free at [http://antivirus.gmu.edu](http://antivirus.gmu.edu).

Students owning Macs or Linux should be aware that some courses may use software that only runs on Windows. You can set up a Mac computer with Boot Camp or virtualization software so Windows will also run on it. Watch [http://support.apple.com/kb/VI54?viewlocale=en_US](http://support.apple.com/kb/VI54?viewlocale=en_US) about using Windows on a Mac. Computers running Linux can also be configured with virtualization software or configured to dual boot with Windows.

Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

**Course-specific Hardware/Software:**

Access to MATLAB is required to complete assignments made during this class. MATLAB is available through a site license with the Volgenau School of Information Technology and Engineering or College of Science in common-space computer laboratories in the Nguyen Engineering Building. It is also available to Mason Students through the virtual computer lab ([http://doit.gmu.edu/staffSection.asp?page=vcl](http://doit.gmu.edu/staffSection.asp?page=vcl)). Student only licenses to MATLAB are available for a nominal fee. ([http://www.mathworks.com/academia/student_version/](http://www.mathworks.com/academia/student_version/))

**Important:** You will use Blackboard and Respondus LockDown Browser to take the mid-term and final exams. The Respondus LockDown Browser allows you to take tests in a remote location. The exam session will be monitored and recorded. You will need a web cam and the Respondus LockDown software which can be downloaded at no cost. If you have any privacy concerns, please contact me within the first week of class. If you do not have concerns, please follow the instructions for installing the Respondus Lockdown software and complete the sample quiz the first week of class [provided under “Respondus Monitor” on the Course menu (after entering the course)].

**To Access Blackboard**

2. Login using your NETID and password.
3. Click on the ‘Courses” tab.

4. Click on **201870 – Master - BENG 101-DL1 (Spring 2018)** under the “9.1 Course List” heading.

**Technical Help**

— If you have difficulty with accessing Blackboard, please contact the ITU Support Center at 703.993.8870 or support@gmu.edu.

— If you have trouble with using the features in Blackboard, email courses@gmu.edu.

**Course Prerequisites:** No prerequisites. While this class may be open to all interested University students, it is a core class for the bioengineering major or associated majors.

**Course Description and Vision**

This course will survey and familiarize students with the many facets of bioengineering. In particular, this course:

- discusses the breadth of activities and career paths in bioengineering
- explores biological systems with an emphasis on quantitative and engineering tools and concepts
- illustrates the impact of bioengineering on biological research, health care, and medicine, through devices, diagnostic tools, and methods.
- allows students to develop skills in using computational tools and engineering design to solve bioengineering problems.

This course will be fully online (including exams); we will use Blackboard 9.1; and we will use other means of keeping in touch such as: email and telephone. In a typical week:

- accomplish online activities and respond to weekly requirements
- work on assignments to be submitted in the Blackboard assignment drop box according to the assignment schedule.

Though the delivery method is different, it should take you the same amount to time as a typical undergraduate course. **Expect to spend 8 to 10 hours on coursework each week** (this includes the time you would have spent in a classroom). It is critical to keep up with weekly requirements. The course week will run from Monday – Sunday.

The weekly folder will be available each Monday morning by 9am. Click on ‘**Course Content**’ on the course menu in Blackboard to see all required activities and assignments for the week.

**Course Policies**

Late assignments and quizzes will not be accepted. The lowest Matlab assignment will be dropped from consideration when determining your final grade.
• Midterm Exam (20%) The exam will be a combination of multiple-choice and short answer questions.

• Final Exam (30%) The exam will be a combination of multiple-choice and short answer questions.

• MATLAB assignments (20% drop the lowest of MATLAB assignments)

MATLAB assignments may be collaborative or individual. Results should be submitted at the end of class that count towards your “attendance and participation” or your “MATLAB assignments” grade; other problems might be assigned as homework. Missed in-class assignments and homework will not be made up. The lowest assignment will be dropped from consideration when determining your final grade.

• Class Participation [short essays (refer to “Essay Rubric” for grading criteria under “Rubrics” on Course menu), discussion responses-(refer to “Discussion Rubric for grading criteria under “Rubrics” on Course menu), and quizzes 15%)]

Short essays will have a prompt and students will write an individual blog post.

Discussions will take place in groups. In each discussion, students will be asked to develop an initial discussion post (based on a discussion prompt provided by the instructor) and reply to at least two other students.

• Final Group Project (15%) This is a group project. The deliverables are a 5-7 page paper and an oral presentation that can be in the form of a video or narrated PowerPoint slides. Students will be provided with a list of resources developed by a University librarian for this assignment. Also, under “Rubrics” on the Course menu in Blackboard, see the folder called “Project Rubric” for assessment information and formatting guidelines.
Grading Criteria

A = 94-100  A- = 90-93  B+ = 87-89  B = 83-86  B- = 80-82  C+ = 76-79  C = 70-75  D = 60-69  F = 0-59

A: Excellent performance; sharp insight; articulate; superior writing ability; able to relate material to previous experience and learning; an example for others to follow. B: Good performance; writes thoughts clearly; accomplishes more than minimum requirements; solid performance. C: Satisfactory performance; accomplishes minimum requirements; communicates at generally acceptable level; satisfactory understanding of concepts at basic level. D/F: Quality and quantity of work and participation is below average and unacceptable.

Instructor-Student Communication

I will respond to your emails within 48 hours. If I will be away from email for more than one day, I will post an announcement in the Blackboard course folder.

Get in the habit of checking Blackboard and your gmu.edu email at least daily for announcements, discussion inputs, or updates.

Before sending an email, please check the following (available on your Blackboard course menu) unless the email is of a personal nature:

1. Syllabus
2. Help forum
3. Blackboard videos on how to use Blackboard features, and
4. Technology Requirements.

Feel free to respond to other students in the Help forum if you know the answer.

Email requirements:

1. Put BENG101 at the beginning of the Subject Line every time you e-mail me so I may easily identify class e-mail.
2. Get in the habit of checking Blackboard and your Mason email account at least daily for announcements, discussion inputs, or updates.
3. Keep your mailbox maintained so that messages are not rejected for being over quota.
4. You may forward your Mason e-mail to other accounts but
5. Always communicate with me and your fellow students using Mason e-mail for verification of your identity.

Academic Integrity
Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See http://academicintegrity.gmu.edu/distance].

Honor Code
Students must adhere to the guidelines of the George Mason University Honor Code [See http://oai.gmu.edu/the-mason-honor-code].
Spring 2018

MasonLive/Email
Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See https://thanatos.gmu.edu/masonlive/login].

Patriot Pass
Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See https://thanatos.gmu.edu/passwordchange/index.jsp].

Responsible Use of Computing
Students must follow the university policy for Responsible Use of Computing. [See http://universitypolicy.gmu.edu/1301gen.html].

Students with Disabilities
Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu].

University Libraries
University Libraries provides resources for distance students. [See http://library.gmu.edu/distance].

Writing Center
The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See http://writingcenter.gmu.edu]. You can now sign up for an Online Writing Lab (OWL) session just like you sign up for a face-to-face session in the Writing Center, which means YOU set the date and time of the appointment! Learn more about the Online Writing Lab (OWL).

Counseling and Psychological Services
The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See http://caps.gmu.edu].

Family Educational Rights and Privacy Act (FERPA)
The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See http://registrar.gmu.edu/privacy].

Other Considerations
If there are any issues related to religious holidays, please inform the instructor the first week of class.
Learning Outcomes

By the end of this course, students will be able to…

1. Explain with examples what the engineering profession is about, describe the relations between the different functions of engineers and discuss what biomedical engineers do.
2. Explain and illustrate how important functions of the human body (cardiac contraction, blood circulation, electrophysiology) are studied using principles of engineering and quantitative methods.
3. Develop the necessary skillset to analyze problems related to bioengineering using Matlab, one of the commonly used tools in most areas of engineering.
4. Acquire through self-initiated research technical knowledge related course material.
5. Contrast the field of bioengineering to other fields of study and make an informed decision on whether to pursue a career in bioengineering.

Learning Outcomes related to degree requirements

- Students will have an understanding of professional responsibility. They will know that professional decisions need to be consistent with the safety, health and welfare of the public, they will be aware of issues of conflict of interest, and they will treat each other fairly, recognizing diversity and intellectual property.
- Students will communicate effectively both orally and in writing.
- Students will have the broad education necessary to understand the impact of engineering in a global, economic, environmental, and societal context, they are familiar with globalization, and they understand that the impact of their profession may be different in societies at different stages of economic development.
- Students recognize the need to seek additional information when faced with an unfamiliar problem.
- Students are familiar with contemporary and often contentious issues such as regulation, and the cost and quality of health care.
### Weekly Course Schedule

(This schedule may change due to unforeseen circumstances. I will post an announcement in Blackboard about any changes. It is the student’s responsibility to be aware of any changes on the course schedule. It is the student’s responsibility to read the Announcements.)

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings and Videos</th>
<th>Participation</th>
<th>Assignments</th>
</tr>
</thead>
</table>
| 1 (1/22-1/28) | Welcome and Introduction | — Reading Saltzman, Chapter 1  
Learning Outcome #2  
— Bioengineering Careers – Becoming a Biomedical Engineer  
http://careersouthere.com/bioengineering-careers-becoming-a-biomedical-engineer/  
— Mini-lecture: Overview of Final Paper and Presentation | Student Introductions (3 extra-credit points-participation) | -Syllabus Quiz  
1/28 by midnight  
-Introductions by students  
Sun., 1/28 by midnight |
— Reading: Saltzman, Chapter 2 (pp. 31-59) and Chapter 3  
o Mini-lecture: Biomolecules Part 1  
o Mini-lecture: Biomolecules Part 2 | Discussion: First posting due 2/8 by midnight | -Short answer quiz based on readings due Sun., 2/4 by midnight  
- Sample lockdown browser quiz due Sun., 2/4 by midnight |
| 3 (2/5-2/11) | Unit 1: Biomolecules, Cells, and Cell Communications | — Topic: Cell Communications: Chemical & Electrical  
— Reading: Saltzman, Chapter 4 (pp. 141-150) and Chapter 5  
Cell Communications: Chemical & Electrical. Saltzman: Chapter 6 (pp. 205-221)  
o Mini-lecture: Cell Communications Part 1  
o Mini-lecture: Cell Communications Part 2 | Two responses due 2/11 by midnight | MATLAB Workshop 1 Assignment due Sun., 2/11 by midnight |
| 4 (2/12-2/18) | Unit 2: The cardiovascular system, bioinstrumentation and neuroengineering | — Reading: Saltzman, Chapter 8  
Dr. Peter Katona  
o Mini-lecture: Origins of Biomedical Signals,  
o Mini-lecture: Signals as Aids for Diagnosis and Therapy #1  
o Mini-lecture: Signals as Aids for Diagnosis and Therapy #2  
o Mini-lecture: ECG Recording and Analysis  
o Mini-lecture: Frequency content of Signals | Short Essay Due 2/18 by midnight | - |
<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Learning Outcome 2 &amp; 3</th>
<th>MATLAB Workshop 2 – Matrices, Programming basics Learning Outcome #3</th>
</tr>
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| 5    | 2/19-2/25   | Unit 2: The cardiovascular system, bioinstrumentation and neuroengineering | - Mini-lecture: MATLAB Workshop #2, Part A  
- Mini-lecture: MATLAB Workshop #2, Part B |
|      |             |                         | Topic: Bioinstrumentation                                      |
|      |             | Reading: Saltzman, Chapter 11 Learning Outcome #2 | Two responses to other students’ due 2/25 at midnight |
|      |             |                         | Discussion: First posting due 2/22 at midnight | - Quiz on cardiovascular Mini-lectures and readings Due Sun., 2/25 at midnight  
MATLAB Workshop 2 Assignment due Sun., 2/25 at midnight |
| 6    | 2/26-3/4    | Unit 2: The cardiovascular system, bioinstrumentation and neuroengineering | MATLAB Workshop 3 – Relational operators and scripting |
|      |             |                         | - Mini-lecture: MATLAB Workshop #3, Part A  
- Mini-lecture: MATLAB Workshop #3, Part B |
|      |             |                         | Dr. Joseph Pancrazio  
- Mini-lecture: Introduction to Neural Engineering  
- Mini-lecture: Recording Technologies  
- Mini-lecture: Alternative to Conventional Metal Microelectrodes  
- Mini-lecture: Emerging Technologies |
|      |             |                         | Project Selection: First topic posting due 3/1 by midnight  
Final Project selection and team identification due by 3/4 by midnight | MATLAB Workshop 3 Assignment due Sun., 3/4 by midnight |
| 7    | 3/5-3/11    | Unit 2: The cardiovascular system, bioinstrumentation and neuroengineering | MATLAB Workshop 4 – ECG Signal analysis  
- Mini-lecture: MATLAB Workshop #4, Part A  
- Mini-lecture: MATLAB Workshop #4, Part B Learning Outcome #3 |
|      |             |                         | Midterm Exam - Open Wed., 3/7 at 6am until Fri., 3/9 at midnight. | MATLAB Workshop 4 Assignment due Sun., 3/11 by midnight  
Midterm Exam due Fri., 3/9 by midnight. Opens 3/7 at 6am. |
| 8    | 3/12-3/18   | SPRING BREAK!           |                                                |
| 9    | 3/19-3/25   | Unit 3: Biomechanics, Bioimaging, and biomaterials | Reading: Saltzman: Chapter 10 and Chapter 11 |
|      |             |                         | Dr. Qi Wei  
- Mini-lecture: Introduction to Biomechanics  
- Mini-lecture: Stress and Strain  
- Mini-lecture: Muscle and Tendon |
|      |             |                         | Dr. Siddhartha Sikdar  
- Mini-lecture: Medical Imaging | Short Essay due 3/25 by midnight |
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<tr>
<th>Week</th>
<th>Date</th>
<th>Learning Outcomes</th>
<th>Unit 3: Biomechanics, Bioimaging, and biomaterials</th>
<th>Learning Outcomes #3</th>
<th>MATLAB Workshop 6 - Peak detection without a fixed baseline, Image averaging</th>
<th>Learning Outcome #3</th>
<th>Discussion: First posting due 3/29 by midnight</th>
<th>Two responses to other students’ due 4/1 at midnight</th>
<th>Quiz on imaging and biomechanics Mini-lectures and chapter 11 due Sun., 4/1 by midnight</th>
<th>MATLAB Workshop 5 Assignment due 4/8 by midnight</th>
<th>MATLAB Workshop 6 Assignment due 4/15 by midnight</th>
<th>Quiz on, MRI, Ultrasound, and Microfluidics Mini-lectures and Chapter 15 Due Sun., 4/15 at midnight</th>
<th>Discussion: First posting due 4/19 by midnight</th>
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<tbody>
<tr>
<td>13</td>
<td>(4/16-4/22)</td>
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<td>Topic: Biomaterials &amp; Artificial Organs (Hemodialysis &amp; Membrane Oxygenators). o Reading: Saltzman, Chapter 15 o TED TALK: Can we grow organs? Learning Outcome #2</td>
<td>Unit 4: Bimolecular engineering,</td>
<td>Topic: Artificial Heart &amp; Biohybrid organs o Reading: Saltzman, Chapter 15</td>
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| Learning Outcome #2 | Nanotechnology and Global Health | Video: Ethics of Biotechnology  
Topic: Biomolecular engineering.  
- Reading Saltzman, Chapter 13  
- Mini-lecture: Mass Transport, Part 1  
- Mini-lecture: Mass Transport, Part 2 | One or more responses to other students’ first posting due 4/22 by midnight |
|---|---|---|
| 14  
(4/23-4/29) | Unit 4: Biomolecular engineering, Nanotechnology and Global Health | MATLAB Workshop 7 – Functions, debugging techniques  
- Mini-lecture: MATLAB Workshop #7, Part A  
- Mini-lecture: MATLAB Workshop #7, Part B |
| Learning Outcome #3 | | Final Project Due 5-7 page written and online presentation both due 4/26 by midnight  
MATLAB Workshop 7 Assignment due 4/29 by midnight |
| 15  
(4/30-5/6) | Unit 4: Biomolecular engineering, Nanotechnology and Global Health | Dr. Caitlin Burke-Laurence  
- Mini-lecture: Overview of Therapeutic Ultrasound  
- Mini-lecture: Therapeutic Ultrasound  
- Mini-lecture: Strategies for Ultrasound Triggered Release/Delivery  
- Mini-lecture: Clinical Applications and Preclinical Research  
YouTube Mini-lecture: Idea to IDE: A Medical Device in the Making |
| Learning Outcomes 1, 2, & 5 | | Short Essay Due 5/6 by midnight. |
| Semester Review | | Final Exam Open  
Wed., 5/9 at 6am until Fri., 5/11 at midnight. |