BENG525  
Spring of 2018  
Neural Engineering

Logistics  
**Lectures:** W 4:40 pm to 7:10 pm.  
**Lab sessions:** in lab 3906 of the Engineering Building.  
**Instructor:** Dr. Nathalia Peixoto, npeixoto@gmu.edu - *she wants to be called Nathalia.*  
Office # 3912, Nguyen Engineering Building  
Nathalia’s office hours: Mondays 11 am to 12 pm, in room 3912.

Objective: Overview of Neural Engineering for graduate and senior undergraduate students with Engineering background. The sequence of classes is designed to cover from fundamentals of neurophysiology through applications of neural prosthesis devices such as retinal and cochlear implants. Other important aspects of Neural Engineering to be discussed include the brain-machine interface, instrumentation for interfacing electronics to the nervous system, and sensors for neural research.

Prerequisites: While there is no formal prerequisite, it is expected that the students show interest in these areas, and that they acquire the necessary knowledge throughout the semester, either by interaction with the instructor and other students, or through the reading of support textbooks.

Main Textbook:  
Pertinent journal papers will be uploaded to Blackboard throughout the semester. Textbook is available through the GMU library, online.

Supplementary texts:  

Obs. Do not buy any of the textbooks: they are meant as a guide for you to know which areas the course will cover. Some (if not all) of these books will be on reserve in Fenwick.

Course structure: the course consists of weekly lectures, labs, guest lectures, homework, one project, and two exams. Exams will be closed book and closed notes. A project presentation is due by the end of the semester (see details below). Participation in class will be considered as part of the grade; the hope is that most of the sessions will be of great interest to students and arouse discussion in class, either in the form of possible projects in neural engineering, or as analysis of previously emailed journal papers.
Grade:
Midterm 30%
Final exam 30%
Participation in class and homework 20%
Project 20%

Project:
- Topic to be selected by each student within first 3 weeks of class.
- 20 min presentation (with slides) by the end of the semester.
- 4 page paper required in IEEE style by the end of the semester.
- Classmates will grade each presentation. Grades will be based on: clarity of explanation; creativity; knowledge of the topic and background; consistence; quality of presentation.
- Experimental topics preferred but not required.

Homework is due on Blackboard. Late homework: 20%/day penalty.

Course outline. For a more detailed description of the material to be covered, please refer to the weekly scheduled posted on Blackboard.

week 1:
Design criteria for a prosthetic device; bottlenecks.
Brainstorming with students: why “Neural Engineering”.

week 2:
Charge passage to and from the brain. Metals for use in implants.
Fundamentals of data analysis for implanted materials (electrochemistry and histology).

week 3:
Lab 1 – electrodes and neuronal cultures.

week 4:
Interfacing electronics to the body.
High pass and low pass electrodes
Drug delivery and neurochemical analysis

week 5
Microprobes (Gaithersburg, MD) visit and talk.

week 6:
Fabrication methods for implantable prosthesis
Sieve probes, shank probes, brain slice applications (non implantable)
Brain-machine interfaces. Practical implementations and modeling.

**week 7:**
Non-invasive methods of signal acquisition for BMI.
Pre-midterm review.

**week 8:**
Lab 2 – followup, surgery, and interfaces.

**week 9:**
Midterm (chapters 1 through 4 of textbook).

**week 10:**
Neurorobotics, chapter 4.

**week 11:**
Literature review for neurorobotics, state-of-the-art technologies

**week 12:**
Neuromuscular stimulation; lower limb implants

**week 13:**
Neural implant examples: retinal and cochlear
Models of electrodes, EM field distribution in conductive media

**week 14:**
Seizure detection and prediction

**week 15:**
Project presentations (slides) and IEEE formatted paper.

**week 16:**
Final exam.

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**IMPORTANT INFORMATION**

**ACADEMIC INTEGRITY**

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else’s work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class
will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

**GMU EMAIL ACCOUNTS:** Students must use their Mason email account to receive important university information, including messages related to the class. See [http://masonlive.gmu.edu](http://masonlive.gmu.edu) for more information

**OFFICE OF DISABILITY SERVICES:** If you are a student with a disability and you need academic accommodations, please see me during the first week of classes and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. [http://ods.gmu.edu](http://ods.gmu.edu)

**OTHER USEFUL CAMPUS RESOURCES:**
- **WRITING CENTER:** A114 Robinson Hall; (703) 993-1200; [http://writingcenter.gmu.edu](http://writingcenter.gmu.edu)
- **UNIVERSITY LIBRARIES “Ask a Librarian”** [http://library.gmu.edu/mudge/IM/IMRef.html](http://library.gmu.edu/mudge/IM/IMRef.html)

**UNIVERSITY POLICIES**
The University Catalog, [http://catalog.gmu.edu](http://catalog.gmu.edu), is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at [http://universitypolicy.gmu.edu/](http://universitypolicy.gmu.edu/).

**OFFICE OF STUDENT CONDUCT:** [http://studentconduct.gmu.edu/](http://studentconduct.gmu.edu/)

**WAVES: Wellness, Alcohol and Violence Education and Services**
WAVES promotes wellness within the Mason community through health education, alcohol/drug assessment and education, and violence awareness, prevention and sexual assault response. We help students make healthy, safe choices and encourage lifelong, thoughtful healthy decision-making through individualized support, creative programming, and evidence-based education and outreach.

**WAVES office 703-993-9999, SUB I, Suite 3200**

**24-Hour Sexual and Intimate Partner Violence Crisis Line 703-380-1434 waves.gmu.edu**
- 703-360-7273 (Fairfax County Office for Women and Domestic and Sexual Violence Services 25 hotline)
- 703-228-4848 (Arlington County Domestic Violence Services Hotline)
- 703-368-4141 (Prince William County Sexual Assault Victims Advocacy Services (SAVAS) hotline)
- 1-800-838-8238 (Virginia Family Violence and Sexual Assault Hotline)
- 1-800-656-HOPE (Rape, Abuse and Incest National Network) [https://ohl.rainn.org/online/](https://ohl.rainn.org/online/)

**CAPS: Counseling and Psychological Services**
Counseling and Psychological Services (CAPS) provides a wide range of free confidential services to students, faculty, and staff. Services are provided by a staff of professional clinical psychologists, social workers, counselors, learning specialists, and psychiatric providers. CAPS individual and group counseling, workshops, and outreach programs are designed to enhance students’ personal experience and academic performance.

Visit us at [caps.gmu.edu](http://caps.gmu.edu) for additional resources.
For consultation or emergency assistance during office hours call 703-993-2380. 
For assistance during non-office hours, call University Police at 703-993-4357. 
703-527-4077 (CrisisLink) 
1-800-273-8255 (National Suicide Prevention Lifeline) 
1-877-838-2838 (Veterans' Crisis Hotline)

**Student Health Services (SHS)** — Provides *confidential* health care to enrolled students in emergency and non-emergency circumstances on the Fairfax, Arlington and Prince William campuses. If there is a medical emergency and Student Health Services (SHS) is closed, please contact the free after-hours nurse ((703) 993-2831), a hospital emergency room, an urgent care facility, or call 911.

**SUB 1, Suite 2300, 703-993-2831**

**University Police:**
Emergency: 911
Non-Emergency: (703) 993-2810
Reporting a Crime (Crime Solvers Anonymous Tip Hot-Line): (703) 993-4111
Mason Police Website: [http://police.gmu.edu/](http://police.gmu.edu/)
Eric Heath, Chief of Police Phone: (703) 993-3840 E-mail: eheath2@gmu.edu