ILLINOIS
Bioengineering
GRAINGER COLLEGE OF ENGINEERING

NE 100: Introduction to Neural Engineering

Meeting time: Monday/Wednesday 9:00 – 9:50 AM
Location: 2101 Everitt Laboratory

Credit hours: 2
Semester: Fall
Prerequisites: NA

Instructor Information

Name	Min Jee Jang, Ph.D.
Contact Information	mjjang@illinois.edu
Office Location	3110 Everitt Laboratory
Office Hours	by appointment only

Course Description

This course is a broad introduction to the fundamental principles and ever-advancing technologies at the interface of neuroscience and bioengineering. We will explore the basics of neuroscience/anatomy and how neural engineering tools are used to measure and modulate the nervous system in the context of neurological function, dysfunction, and injury. The course is divided into five sections: 1) Neuroanatomy and neurophysiology; 2) Technologies for monitoring the structure and activity of the nervous system: CT, MRI, EEG, patch-clamping, optogenetics; 3) Devices for replacing and restoring neuronal function: implantable electrodes, brain-computer interface, deep brain stimulation, and prosthetics; 4) Computational analysis and modeling; and 5) Neural tissue engineering. The course will cover the fundamentals from the level of single cells, neural circuits, networks, systems, and, ultimately, behavior.

Philosophy of Instruction

Classroom time will be composed of mini-lectures with numerous in-class problems completed in real-time by students. Active learning provided through in-class exercises will be included to nurture interest and support persistence. Class lectures will be based on an integrated method that requires the students to reconstruct and apply what they are learning. The interactive exercises are designed to reinforce learning and to help students with their overall presentation, group interaction, and communication skills. Throughout the class, students will have to navigate through the three-dimensional structure of the brain, its vasculature, and radiological brain images. The clinical correlation lectures serve to help the students synthesize, interpret, and remember neuroanatomical concepts in terms of function and clinical scenarios and implications.

Course Objectives

Upon completion of this course, the students should:

- understand the basic principles of anatomy and function of the nervous systems
- understand the basic principles of neurophysiologic recordings and imaging technologies.
- be able to explain several applications of neural engineering in sensory, motor, and neurological disorders.
- understand the current challenges facing the field of neural engineering.
- be able to describe engineering-oriented technologies for brain imaging, analysis, and intervention.
- be familiar with reading research articles

Course Format

- This class meets for two, 50-minute lecture periods each week for the Fall semester
- Students are expected to spend 4 hours outside of class per week.

Textbook and Reading Materials

The main textbook is Neural Engineering (Springer 2nd Edition; 2009) by Bin He. The students will be given reading materials, including research papers and book chapters.

Tentative Schedule

Week	Topic
1	Introduction & organization of the nervous system (8/26, 8/28)
2	Neuroanatomy of the central nervous system (9/2, 9/4)
3	The peripheral nervous system with sensory and motor (9/9, 9/11)
4	Neurocytology (9/16, 9/18)
5	Neurophysiology (9/23, 9/25)
6	Guest lecture (9/30), Pathology of neurological disorders (10/2)
7	Review (online – 10/7), **Midterm (10/9)**
8	Neuroimaging I – clinical imaging technologies (10/14, 10/16)
9	Neuroimaging II – research imaging technologies (10/21, 10/23)
10	Neuromodulation I (10/28, 10/30)
11	Neuromodulation II (11/4, 11/6)
12	Computational approaches to neural engineering (11/11, 11/13)
13	Neural tissue engineering (11/18, 11/20)
14	Neurogenetics & gene therapy (12/2, 12/4)
15	Review (12/9, 12/11)
16	**Final exam**

Course Website

https://canvas.illinois.edu/courses/50698

Grading

In-class engagement exercises: 15%
Homework: 50%
Midterm exam: 15%
Final exam: 20%

In-Class Engagement Exercises

Students are expected to complete quick questions during class and at the end of most lectures, these will be scored for attendance and participation.

Homework

There are 3 homework assignments based on class interactive team-based exercises.

Overall Course Grade

The overall course grade is given on absolute scale and will not be curved. Concerns about individual assignments or grades should be expressed to the instructor promptly. This course will be assigning +/- letter grades.

- A+>97%>A>93%>A-
- B+>87%>B>83%>B-
- C+>77%>C>73%>C-
- D+>67%>D>63%>D-
- F<60%

Late Policy

Late assignments will in occur a 10% penalty per day. After 7 days it is at the discretion of the instructor to accept late work or not. Exceptions to this policy will only be made if a student communicates with the instructor AT LEAST 24 hours in advance of the original assignment due date. If you run into issues this semester and you are behind on work, please communicate early and often with the teaching staff. We want you to be successful and we are here to help!

Course Policies

- Attendance**:** Students are expected to attend every class with the exception of pre-authorized absences or unavoidable emergencies.
- Course-related communications**:** Course announcements will be sent out to the class roster via Compass; please check your email regularly. For general course questions and information, please first consult the syllabus. If your question/issue is still not answered/addressed, please email the course instructor at cabest@illinois.edu.
- Laptops and mobile devices**:** Mobile devices should be on silent and out of sight during class. Laptops and mobile phones may be used for course-related tasks only (e.g., to take notes or investigate relevant topics, answer polling questions).

Expectations for Students

- Participate throughout each week.
- Consider and respect others' opinions.
- Complete all assignments on time.
- Discuss concerns privately with the instructor.

Expectations for Instructors

- Be available for face-to-face discussion.
- Respond promptly to students' concerns.
- Grade objectively and promptly return graded assignments.
- Endeavor to accommodate differences in students' learning ability.

COVID Policies

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, maintaining social distance (at least 6 feet from others at all times), disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non- compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: https://studentcode.illinois.edu/.

Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (https://studentcode.illinois.edu/article1/part4/1-404/). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: https://studentcode.illinois.edu/article1/part4/1-401/. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/. Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

In this course you are expected to produce your own work in all laboratory reports. You may collaborate with your partner, but each report must be written by each individual separately. We will compare all reports each week against current classmates. If your report has a close match with another it will be flagged and investigated.

In this course the use of calculators or electronic devices (cell phones or others) will not be allowed during examinations. If you are found using one, it will be investigated as potential cheating.

Anti-Racism and Inclusivity

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Disability Related Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to https://www.disability.illinois.edu. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

Family Educational Rights and Privacy Act

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious-observances/ to request appropriate accommodations. This should be done in the first two weeks of classes.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University’s Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: https://wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: https://wecare.illinois.edu/.