

TENTATIVE SYLLABUS ONLY – OFFICIAL SYLLABUS WILL BE HANDED OUT FIRST DAY OF CLASS

ENGR 311 Electrophysiology of the Central Nervous System

Instructor: Dr. Harry Blaise (harry.blaise@trincoll.edu)

Class Time: TR 8-9:15

Classroom Location: tbd

Office Hours: tbd

(and by appointment)

Office Location: MECC 395

Course Description: This introductory course in cellular neurophysiology presents a modern and important body of knowledge in a highly integrated fashion drawing from the contributions of anatomists, physiologists, and electrical engineers. The basic biochemical properties of the membrane, sensory transduction, neural transmission, and synaptic interaction are considered in sequential order. Then the collective action of neurons in the form of compound electrical responses, and the electroencephalogram are discussed as a means of understanding the neural circuitry involved in various behavioral modalities such as sleep-waking oscillation, pain modulation, etc. Particular emphasis is placed on experimental design. Ongoing research studies illustrating the concepts and techniques presented in the course will be discussed. Open to all junior and senior life science and physical science majors.

Required Text:

Blum & Rutkove, Eds., **The Clinical Neurophysiology Primer**, Humana Press, 2007. Note: The textbook is open-source and is freely available on the Moodle course page or via this link accessible only while connected to Trinity network: <https://link.springer.com/content/pdf/10.1007/978-1-59745-271-7.pdf>

Course Policy:

- Attendance is mandatory and lateness to class will carry a penalty.
- Spend at least 8-9 hours per week outside of class preparing for the class.
- Do the assigned reading and assignment before coming to class.
- Review your notes for completeness and clarity.
- Homework assignments should be word-processed and uploaded on Moodle before the due date/time, otherwise there will be a late penalty.
- Homework will not be accepted more than 24 hours after the due date/time.
- Students who miss a test due to a **verifiable medical reason (must have doctor's note)** may make up the test as an oral exam administered by the professor no later than a week after the missed test.

Grading Policy: *A range = 94-96.9 %*

Homework: 15 %

Attendance, in-class discussion, and Participation: 5%

3 Tests: 20 % each

Final exam: 20 % (comprehensive of all course topics)

Student Accessibility Resource Center Statement:

Trinity College is committed to creating an inclusive and accessible learning environment consistent with the Americans with Disabilities Act. Students with disabilities who may need some accommodation in order to fully participate in this class are urged to contact the Student Accessibility Resource Center, as soon as possible, to explore accommodations. If you have approval for academic accommodations, please notify me by the end of week two of classes. For those students with accommodations approved after the start of the semester, a minimum of 10 days' notice is required. Please be sure to meet with me privately to discuss implementation.

Course Outline

1. Introduction to Electrophysiology
 - Origins of bioelectricity
 - Characteristics of passive electrical elements
 - Concept of impedance and passive filtering
 - Concept of digitization and signal acquisition
2. Electrical Charge
 - Voltage and potential difference
 - Ohm's law, resistors and capacitors
 - Frequency filters and differential amplifiers
3. Biophysics of Neuronal Membrane
 - Active and passive transport
 - Sodium-Potassium Pump
 - Role of myelin in AP transmission
 - Volume conductor theory
4. Cell to Cell Communication
 - Ion channels and membrane polarity
 - Resting membrane potential
 - Generation and propagation of the action potential (AP)
5. Electrophysiological Recording Techniques
 - In-vitro slice recordings
 - Intracellular and extracellular recordings
 - Brain evoked potentials
 - EEG recordings
 - Applications and limitations of electrophysiology
6. Introduction to Electroencephalography
 - Brain rhythms in the EEG
 - Origins of the EEG
 - The EEG in adults and children
7. EEG Activation Techniques
 - Role of the EEG in the diagnosis of epilepsy
 - Applications of the EEG
 - Seizure detection methods
8. Normal EEG in Adult Patients
 - EEG waveform variants
 - Characteristics and morphology of brain rhythms
 - Role of EEG in sleep states
9. Abnormal EEG in Adults
 - Epileptic seizure types and etiologies
 - Interictal epileptiform discharges (IEDs)
 - Pharmacological treatment of epilepsies
10. Pediatric Epilepsies
 - Features of the premature EEG
 - Lennox-Gastaut Syndrome
 - Treatments for childhood epilepsies
11. Electromyography
 - Muscle cell anatomy and physiology
 - Motor action potential
 - muscle activity recordings
12. Peripheral Neuropathy
 - sEMG (surface EMG) vs. deep EMG
 - EMG signal analysis and quantification
 - Nerve conduction studies (NCS)

Final Exam (comprehensive of all topics): Scheduled by the College during final exam week.