

BME 271: Introduction to Electric Circuits and Bio-electricity

- Credits:** 3
- Prerequisites:** AMS 161 or MAT 127 or 132 or 142 or 171; PHY 127/134 or PHY 132/134 or PHY 142
- Course Instructor:** Professor M. Hassan Arbab, PhD
Department of Biomedical Engineering
HSC L8-050C
Tel. 631-632-1050
Hassan.arbab@stonybrook.edu
- Office hours:** Tuesdays and Thursdays, 11:30 AM —1 PM, or appointment, held online via zoom.
- Course TA(s):** Mahmoud E. Khani, mahmoud.ebrahimkhani@stonybrook.edu, office hours TBD
- Meeting Times/place:** Tuesdays and Thursdays, 9:45—11:05 AM, Online via zoom

Course Description: As an introductory course to circuit design, we begin with fundamental theory of circuit analysis, including time-invariant models of resistors, capacitors, inductors, Ohm's Law, Kirchoff's Laws, nodal and mesh analysis techniques, two-port equivalent circuits, and steady-state AC circuits. The applications of basic circuit analysis techniques in biomedical instrumentation and biological circuitry will be discussed throughout the entire class. In the final part of the course, the principles of cell electrophysiology, bio-potentials and electrical interactions with tissue will be studied.

General Goal: The class provides the foundations for circuit analysis, and an introduction to key topics in Bio-electricity. Electrical circuit analysis (approximately 80% of the course, including midterms 1 and 2).

Specific Objectives: By the end of the class, the students should be able to:

1. To introduce the alphabets of electrical circuits, and apply Kirchoff's current and voltage laws,
2. To simplify circuits using series and parallel equivalents and perform node and mesh analysis,
3. To understand and analyze first and second order linear time-invariant (LTI) circuits,
4. To perform AC analysis and build frequency-domain models of basic electric systems,
5. To understand the origins of bio-potentials and apply circuit analysis techniques to problems in cell electrophysiology,

Course Material:

Required Textbook: Nilsson and Riedel, "Electric Circuits," 10th Edition, 2014. You will also need an account in the Mastering Engineering system, through Pearson Publishing. You can obtain the access code with the purchase of the textbook from the University Bookstore, or online through www.masteringengineering.com
Other relevant materials, specially related to Module 2, will be provided as assigned reading including all lectures notes and assigned readings will be made available through blackboard.

Grading

- 32% mid-term exams (2 exams, 16% each)
- 24% Homework assignments (6 HW assignments, 4% each)
- 20% In-class quizzes
- 20% Final Exam
- 4% Portfolios

Notes allowed during exams: Only for Midterm exams 2 and the final exam you are allowed to use a single page of paper containing only equations, but not containing solved problems, examples, or any other course material. We will check and obtain a copy of your “Equations sheet”.

Tentative Schedule: The course schedule is subject to change throughout the semester. Updated versions of changes will be posted to blackboard. The students are expected to have studied the topic from the textbook, or the reading assignment prior to the class.

Day	Date	Lecture topic, reading assignment	Assignments
Tue	8/25/	Introduction, electrical charge, voltage and current, energy, power, voltage and current sources	Chapter 1
Thu	8/27/	ideal circuit element, Resistors, ohm’s law, Kirchhoff’s laws	Ch. 2
Tue	9/1	Ch.2 continued	
Thu	9/3	Series and parallel resistors, voltage & current division, Wheatstone bridge	Ch. 3, HW #0
Tue	9/8	Node-voltage Analysis	Ch. 4.1-4.8
Thu	9/10	Node-voltage special cases	Ch. 4.9-4.13
Tue	9/15	Mesh-current Analysis	HW #1 due
Thu	9/17	More on Nodal and Mesh Analysis,	Ch. 4
Tue	9/22	Quiz #1 - Special cases of Mesh Analysis	
Thu	9/24	Source transformation,	
Tue	9/29	Thevenin equivalent circuit	
Thu	10/1	More on Thevenin and Norton equivalent circuit	
Tue	10/6	Maximum power transfer, Superposition	HW #2 due
Thu	10/8	Quiz # 2 – Inductors and Capacitors	Ch. 6
Tue	10/13	Fall Break – No class	
Thu	10/15	Review for Midterm 1 – extra problem solving	HW #3 due
Tue	10/20	Mid-term Exam 1 (covering chapters 1-4)	Ch. 7
Thu	10/22	RL, RC (1 st order) circuits, natural response	Ch. 7
Tue	10/27	RL, RC (1 st order) circuits, step response	Ch. 8
Thu	10/29	Quiz # 3 - RLC circuits natural response	
Tue	11/3	RLC Circuits Natural response continued	Ch. 8, HW #4
Thu	11/5	RLC Circuits step response	Ch. 8
Tue	11/10	Sinusoidal Source, Phasors,	Ch. 9, HW #5
Thu	11/12	Quiz # 4 - AC/phasor analysis	Ch. 9,
Tue	11/17	Instantaneous power, average and complex power	Ch. 10
Thu	11/19	Mid-term Exam 2 (covering chapters 4-8)	
Tue	11/24	chapters 9 and 10 continued	HW #6
Thu	11/26	Thanksgiving holiday	
Tue	12/1	Bio-electricity: Origins of bio-potentials, Rs and Cs in biology,	Handouts, HW #7
Thu	12/3	Last day of class: introduction to cell electrophysiology, model of a neuron	

Course Delivery Mode and Structure:

This is a synchronous online course, delivered in the Blackboard learning management system (LMS). Students must be mindful of all course expectations, deliverables and due dates. All assignments and course interactions will utilize internet technologies. See “Technical

Requirements” section for more information. In Blackboard, you will access online lessons, course materials, and resources. Each week has two learning modules; with deadlines on course syllabus. Some variations will occur. Learning Module Quizzes will be open according to the posted course schedule. Please note: students will be required to take the exam at a testing center on or off campus, if available, or will be monitored online through videoconferencing by the course instructor/TA.

How We Will Communicate:

Course-related questions should be posted in the General Questions Forum in the course Discussion board. For personal/private issues, my preferred method of contact is via email listed at the top of this syllabus. If you use Blackboard’s Email Tool, it will automatically include your full name, course name and section when you send me an email. I strive to respond to your emails as soon as possible, but please allow between 24-48 hours for a reply. Your Stony Brook University email must be used for all University related communications. You must have an active Stony Brook University e-mail account and access to the Internet. *All instructor correspondence will be sent to your SBU e-mail account.* Please plan on checking your SBU email account regularly for course related messages. To log in to Stony Brook Google Mail, go to <http://www.stonybrook.edu/mycloud> and sign in with your NetID and password.

Technical Requirements:

This course uses Blackboard for the facilitation of communications between faculty and students, submission of assignments, and posting of grades. The Blackboard course site can be accessed at <https://blackboard.stonybrook.edu> If you are unsure of your NetID, visit <https://it.stonybrook.edu/help/kb/finding-your-netid-and-password> for more information. You are responsible for having a reliable computer and Internet connection throughout the term. **Caution! You will be at a disadvantage if you attempt to complete all coursework on a smart phone or tablet.** It may not be possible to submit the files required for your homework assignments.

The following list details a minimum recommended computer set-up and the software packages you will need to have access to, and be able to use:

- PC with Windows 10
- Macintosh with OS 10.13 or higher
- Latest version of Chrome, Firefox or Explorer; Mac users may use Chrome, Firefox or Safari. (A complete list of supported browsers and operating systems can be found on the My Institution tab of the [Blackboard website](#).)
- 8 GB RAM
- High speed internet connection
- Printer
- Word processing software (Microsoft Word, Pages, etc.)
- Speakers (either internal or external) or headphones
- Ability to download and install free software applications and plug-ins (note: you must have administrator access to install applications and plug-ins).
- Adobe Flash player with the latest update is crucial for playing multiple videos throughout the course

Program Outcomes and Assessment (ABET)

The following list describes particular skills you are expected to learn based on course material: (e) Students gain the ability to identify, formulate, and solve problems at the interface of engineering and biology.

LATE WORK POLICY: For work submitted after the deadline (24 hours max) without serious excuse and note in advance, the student gets 50% credit.

DISABILITY SUPPORT SERVICES (DSS): If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (631) 632-6748 or at sasc@stonybrook.edu. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website:

<http://www.stonybrook.edu/ehs/fire/disabilities>

ACADEMIC INTEGRITY: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website:

https://www.stonybrook.edu/commcms/academic_integrity/index.html

CRITICAL INCIDENT MANAGEMENT: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

RECORDING OF LECTURES: Audio or video recording of lectures by students requires prior permission of the individual lecturer. (Stony Brook University Policy 512).

Electronic Communication Statement: Email and especially email sent via Blackboard (<http://blackboard.stonybrook.edu>) is one of the ways the faculty officially communicates with you for this course. It is your responsibility to make sure that you read your email in your official University email account. For most students that is Google Apps for Education (<http://www.stonybrook.edu/mycloud>), but you may verify your official Electronic Post Office (EPO) address at

<http://it.stonybrook.edu/help/kb/checking-or-changing-your-mail-forwardingaddress-> in-the-epo. If you choose to forward your official University email to another off campus account, faculty are not responsible for any undeliverable messages to your alternative personal accounts. You can set up Google Mail forwarding using these DoIT-provided instructions found at

<http://it.stonybrook.edu/help/kb/setting-up-mail-forwarding-in-google-mail>.

If you need technical assistance, please contact Client Support at (631) 632-9800 or orsupportteam@stonybrook.edu.