Stony Brook University

Syllabus

ESE 273

Microelectronic Circuits
Fall 2020

1. Course Staff and Office Hours

Instructor:	Ridha Kamoua
	Ridha.kamoua@stonybrook.edu
	Light Eng. 237
Class Time:	Monday and Wednesday, 2:40pm – 4:00pm
Location:	Frey Hall 216
Teaching Assistant:	Mustafeez Hassan
Office Hours:	Monday and Wednesday, 12:00pm to 2:00pm via Zoom meetings
	Other hours by appointment

2. Course Description

This is the first integrated circuits class that introduces the students to the fundamentals of the non-linear devices and design of IC amplifiers. The course starts with the introduction to the device physics, operation and modeling of a diode. Operation of MOS transistor, derivation of the large-signal transistor current as a function of the terminal voltages in different regions of operation is then presented, along with the small-signal model. Single-stage amplifier structures are explored, along with the introduction of the implementation of current source and current mirror. Frequency-response of common-source amplifier is presented. The concepts of multi-stage amplification and differential pair are introduced. Operation and modeling of bipolar transistors are presented, along with the common-emitter amplifier. Comparison of MOS and BJT transistor and performance of common-source and common-emitter is presented. Fall and Spring.

Prerequisites: ESE 271

Credits: 3

3. Textbook

Required textbook: ***"Microelectronics Circuit Analysis and Design"*** Donald A. Neamen, McGraw Hill, 4th Edition, 2010, ISBN: 0073380644

References:

- **"Microelectronic Circuits**", Eighth Edition Adel S. Sedra, Kenneth C. (KC) Smith, Tony Chan Carusone, and Vincent Gaudet, *Cengage*, *2019*, ISBN: 9780190853464
- ***"Microelectronics Circuit Analysis and Design",*** *Third Edition,* Muhammad Rashid, *Cengage*, *2017*, ISBN: 9781305635166

4. Course Learning Objectives

- Explores properties, models, and concepts associated with semiconductor devices.
- Provides detailed insight into the internal workings of basic semiconductor devices such as the pn-junction diode, Bipolar Junction Transistor, and MOSFET.
- Systematically develops the analytical tools needed to solve practical device problems

5. Student Learning Outcomes

	Student Outcomes	% contribution
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	90%
3	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	
3	an ability to communicate effectively with a range of audiences.	
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.	10%
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	

6. Schedule

Week 1. 8/23, 8/25	Course overview, Discrete, integrated and emerging electronics. IC fabrication.
Week 2. 8/30, 9/1	Introduction to semiconductors; pn-junction characteristics
Week 3. 9/8, 9/13	pn-junction characteristics; diode model
Week 4. 9/15, 9/20	MOS transistor operation
Week 5. 9/22, 9/27	MOS transistor characteristic: large and small-signal model
Week 6. 9/29, 10/4	DC Analysis, Biasing
Week 7. 10/6, 10/13	Current source; current mirror and active load
Week 8. 10/18, 10/20	Common-source amplifier Frequency response of common-source amplifier
Week 9. 10/25, 10/27	Common-drain and common-gate amplifier
Week 10. 11/1, 11/3	High gain amplifiers: cascoding and cascading
Week 11. 11/8, 11/10	MOS transistor as switch; CMOS inverter
Week 12. 11/15, 11/17	BJT transistor operation and characteristic
Week 13. 11/22, 11/29	BJT small-signal model and common-emitter amplifier
Week 14. 11/1, 12/6	Frequency response of common emitter amplifier

7. Assignments

7.1. Homework Assignments

Homework Assignments will be issued weekly. A full schedule will be made available on Blackboard. (This schedule will be updated as needed.) All assignments will be due one week later and should be uploaded to blackboard as a pdf file.

7.2. Collaboration Policy

Homework assignments are to be completed individually. You may *discuss* them with your classmates. (In fact, you are encouraged to do so using the discussion board in blackboard.) However, you must write up your own solution individually without any help from any other person.

For example, it is fine if you and a friend discuss a problem together, and then separately work out the details and write your own separate solutions. On the other hand, it is not acceptable to share written solutions with another person or to create the written solutions together. In other words, the work you turn in must entirely be your own personal effort.

8. Assessment and Academic Integrity

Your grade will be based on attendance and participation, homework assignments, two midterm examinations, and one final examination.

Homework Assignments	**10%**	**Weekly**
Attendance and participation	**5%**	
Midterm #1	**25%**	**9/29 2:40pm – 4:00pm**
Midterm #2	**25%**	**11/10 2:40pm – 4:00pm**
Final Exam	**35%**	**12/8 5:30pm – 8:00pm**

9. Academic Honesty

Any academic dishonesty on a written homework will result in a zero grade for the assignment for all parties involved.

All exam work must be entirely your own with no collaboration or outside materials/information. Any academic dishonesty on the midterm exams or the final exam will result in failing the course. The case will be submitted to the College of Engineering's Committee on Academic Standing and Appeals.

10. 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-forwarding-address-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 supportteam@stonybrook.edu.

11. Student Accessibility Support Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

12. Academic Integrity Statement

Each student must pursue their academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is 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 at http://www.stonybrook.edu/commcms/academic_integrity/index.html

13. Critical Incident Management Statement

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.