EE336
SEMICONDUCTOR DEVICES

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Course Staff

- Instructor:
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  - Dr. Mohammed M. Farag (mmorsy@ieee.org)
    - 4th Floor ECE Building
- TA: Eng. Mohamed Megahed
- Office hours :
  - Saturday: 12:00 AM - 2:00 PM
- Course Website:

http://eng.alexu.edu.eg/~mmorsy/Courses/Undergraduate\EE336_Semiconductor_Devices\EE336.html

Course Text

- Textbook
  - Hu, Chenming. Modern semiconductor devices for integrated circuits. Prentice Hall, 2010. Book Link
- Reference books
  - "Semiconductor Device Fundamentals 2nd Edition", Robert F. Pierret
  - "Solid State Electronic Devices 6th Edition", Ben Streetman, Sanjay K. Banerjee
  - "Semiconductor Devices – Physics and Technology", S. M. Sze, M. K. Lee

Course Objectives

- Learn and understand the following topics:
  - Semiconductor physics
    - Energy bands and carrier transportation in semiconductors
  - Semiconductor Devices
    - pn-Junction Diode, Bipolar Junction Transistor (BJT), Metal Oxide Semiconductor Field Effect Transistor (MOSFET)
  - Semiconductor Technology
    - Material growth, film formation, photolithography, and fabrication process.
- Learn to use Spice to model and simulate semiconductor devices and circuits

Course Outline

- Describe fundamental principles of wafer fabrication processes in semiconductor technology
- Understand fundamental concepts of solid state physics applied to the semiconductor devices
- Explain general electrical behaviors of semiconductor devices and construct appropriate physical models
- Illustrate structural details and current-voltage characteristics of diode, BJT, and MOSFET devices
- Apply the fundamental understanding of semiconductor devices with knowledge on the limitations of physical models
- Practice modeling and simulation SPICE CAD tools to increase understanding of semiconductor devices taught in the course

Course Organization

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- Semiconductor physics:
  - Energy Bands and Carrier Concentration in Thermal Equilibrium
  - Carrier Transport Phenomena
  - p-n Junctions
- Mid-term Exam
- Semiconductor Devices:
  - Bipolar Transistors and Related Devices
  - MOS Capacitor and MOSFET
  - MESFET and Related Devices

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- Semiconductor Technology:
  - Crystal Growth and Epitaxy
  - Film Formation
  - Lithography and Etching
  - Impurity Doping
  - Integrated Devices

Course Work

- 4-5 Labs
- A Midterm exam
- A project
- A Final Exam
- Tools:
  - Pspice

    http://www.electronics-lab.com/downloads/schematic/013/

Project

- The course project is a survey report about a selected topic.
- The topic of the project can be selected from a suggested list of topics or desired topics (other topics can be also selected after getting the instructor approval).
- The project report should be written similar to a scientific paper published in a conference
- The paper organization should be as follows: Abstract, Introduction, Body (start, progress, state of the art), CAD Tools, Conclusions and Future Work
- **The report submission deadline is 1/1/20115** and maximum number of pages is 10 (IEEE conference proceedings double column format).

http://www.ieee.org/conferences_events/conferences/publishing/templates.html

Suggested Topics

- Micro-Electro Mechanical Systems (MEMS)
- Nano Technology applications in the electronic devices
- 3D MOSFETs and 3D Ics
- Photonic semiconductors
- Quantum Computing
- Ultimate limits of integrated electronics
- Integrated strategy for foundry industry
- Carbon nanotube field effect transistor
- Quantum effects in nanoscale electronic devices
- Non-silicon semiconductor devices
- Other related topics can be accepted after contacting the instructor

Project Grading

- The project can be done individually or in a group up to 5 students maximum.
- The project paper will be graded according to the following guidelines :
  - Originality (no copy and paste) 40%
  - Completeness of information 25%
  - Quality of presentation 20%
  - Organization and referencing 10%
  - Innovations and others 5%

Course Grading

- Steady and persistent effort is rewarded
  - Labs: 30 marks
    - Attendance: 5 marks
    - Lab work: 10 marks
    - Lab exam: 5 marks
    - Project: 10 marks
  - Midterm exam: 30 marks (Equally distributed over the two parts)
  - Final exam: 90 marks (Equally distributed over the two parts)

Useful Links

- https://nanohub.org/
- http://scpd.stanford.edu/search/publicCourseSearchDetails.do?method=load&courseId=12036
- http://www.optique-ingenieur.org/en/courses/OPI_ang_M05_C02/co/Grain_OPI_ang_M05_C02.html
- http://www-inst.eecs.berkeley.edu/~ee130/sp13/
- https://nanohub.org/groups/ece606lundstrom