Course Staff

- **Instructor:**
  - Dr. Mazhar Tayel
  - Dr. Mohammed M. Farag ([mmorsy@ieee.org](mailto:mmorsy@ieee.org))
  - 4th Floor ECE Building

- **TA:** Eng. Mohamed Megahed

- **Office hours:**
  - Saturday: 11:00 AM - 1:00 PM
  - Thursday: 11:00 AM - 1:00 PM

- **Course Website:**
  - [http://eng.alexu.edu.eg/~mmorsy/Courses/Undergraduate/EE336_Semiconductor_Devices/EE336.html](http://eng.alexu.edu.eg/~mmorsy/Courses/Undergraduate/EE336_Semiconductor_Devices/EE336.html)
Course Text

- **Textbook**

- **Reference books**
  - “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

**Dr. Mohammed Farag**
- 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

**Dr. Mazhar Tayel**
- Semiconductor Technology:
  - Crystal Growth and Epitaxy
  - Film Formation
  - Lithography and Etching
  - Impurity Doping
  - Integrated Devices
Course Work

- 5-6 Labs
- A Midterm exam
- A project
- A Final Exam

Tools:
- Pspice
  
Project

- The topic of the project can be selected from a suggested list of topics or desired topics (in case of desired topic, the new topic need to be approved by instructor).

- The project includes reading about the selected topic and writing a scientific paper-like survey highlighting the origin, history, and state-of-the-art works addressing the topic.

- The paper organization should be as follows: Executive Summary, Intro, Body (start, progress, state of the art), CAD Tools, Conclusions and Future Work.

- **The report submission deadline is 15/1/2015** and maximum number of pages is 12 (IEEE double column format).

- The project grading will be based on these criteria: organization, technical writing quality, language usage quality, material relevance, comprehensiveness, and conclusions.
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
Grading

- Steady and persistent effort is rewarded
  - Labs: 30 marks
    - Attendance: 5 marks
    - Lab work: 10 marks
    - Lab exam / project: 15 marks
  - Midterm exam: 30 marks (Equally distributed over the two parts)
  - Final exam: 90 marks (Equally distributed over the two parts)
About the Lectures

- Lectures will make use of slides
  - Slides are great!
    - Nice pictures to explain concepts
    - Good addition for course text
    - I can annotate them with a tablet PC
    - I can switch to the tools and listings mid-lecture
  - Slides are horrible!
    - They make me teach 30% faster (really)
    - They give you the sense that this is all easy stuff (it's not)
    - They make you fall asleep
    - They make me lazy
    - They make me waste time looking for clipart
  - Slides are a two-edged sword
    - I encourage you to be active and take notes
    - I may fall back to blackboard-based teaching occasionally

EE 336 Semiconductor Devices
Useful Links

- https://nanohub.org/
- http://www-inst.eecs.berkeley.edu/~ee130/sp13/
- https://nanohub.org/groups/ece606lundstrom