

Nanoelectronics and Nanotechnology (奈米電子及奈米技術)

Course level: Graduate students

Course goals: This course is intended to introduce fundamental knowledge of solid-state electronic materials properties, the technology for nano fabrication and semiconductor devices as well. Lab practicing is also designed to allow students have hand-on experiences. Finally, nano-scaled one dimensional, two dimensional materials and devices are introduced. Students will also need to present designated topics and case study by using the knowledge they have learned in this class.

Pre-requisite: Electron theory in solids (preferred but not mandatory)

Text Book:

A: "Modern Physics for Engineers," Jasprit Singh, John Wiley & Sons, 1999 (ISBN 0-471-33044-2)

B: "Semiconductor Devices: Physics and technology," S. M. Sze, John Wiley & Sons, 2002, 2nd edition. (ISBN 0-471-33372-7)

C: "Nanoelectronics and information technology" Rainer Waser, Wiley-VCH, 2005 (ISBN-13:978-3-527-40542-8, ISBN-10: 3-527-40542-9)

Course Outline

1. Introduction/Solid-state-electronic properties (2/20) Book A, B
2. Carrier concentration and density of states (2/27) Book A, B
3. Carrier transport (3/05) Book B
4. PN junction (3/12) Book B
- Exam 1 (3/19)
5. Field effect transistors (3/26) Book B
6. Lab practicing 1: FET measurements (4/02)
7. Schottky barrier, Ohmic contacts, and MESFET (4/09) Book B
8. Lab practicing 2: MESFET, Ohmic and Schottky contact measurements (4/16)
9. Bipolar transistors (4/23) Book B
10. Lab practicing 3: BJT/HBT measurements (4/30)
11. Light-emitting-diodes, Laser diodes, Photodetectors, Solar cells, Tunneling

- devices/ Nano materials properties (5/07) Book B/ Book C
12. Oral presentation in designated devices: MOSFET, BJT, MOSFET/Schottky/Ohmic contacts (5/14)
 13. Oral presentation in designated devices: MOSFET, BJT, MOSFET/Schottky/Ohmic contacts (5/21)
 14. Oral presentation in designated devices: MOSFET, BJT, MOSFET/Schottky/Ohmic contacts (5/28)
 15. Final exam 2 (6/4)
 16. In-class Presentation (6/11)

Grading: Exam 1- 25%, Exam 2- 25%, Oral presentation in designated devices 15%, In class presentation 15%, Lab practicing with reports 15%, attendance & contribution to the class 5%.

1. For the Exam 1 and Exam 2: Closed book exams.
2. For the oral presentation in designated devices: students will present a designated topic from one of the three devices (MOSFET, BJT, MOSFET/Schottky/Ohmic contacts) and will be asked questions by the instructor and the class.
3. For the Lab practicing: Measurements of the devices with written reports including the principle, measurement setup and steps, results and discussion, and conclusion.
4. For the In-class presentation: Each student is allowed to give a talk in 15 mins and the Q & A in 5 mins. The grade for the presentation will be assessed by the whole class. English is required for the presentation. Language fluency may be considered in grading. Students need to present one major paper and include a few references in the presentation. Students are required to present the topic by **utilizing the knowledge they have learned in this class**. The significance, organization, depth/scientific sound, speaking fluency, and Q&A will be evaluated for the presentation.