

# **Advanced Transistor Physics and Technology Course Syllabus**

## **Course Description**

A course on semiconductor device physics focused on MOSFET physics and device technology. Course will cover (i) basic long-channel MOSFET physics and models, (ii) scaling phenomena, and (iii) novel channel materials for future transistors. Students will be able to understand the challenges of scaling devices to the sub-10 nm node from both device physics and fabrication technology perspectives. Furthermore, students will be able to predict device electrical characteristics from knowledge of device structures and materials parameters as well as utilize electrical characteristics to infer material properties.

## **Course Schedule**

- Week 1 – Review of Current Transport Mechanisms (drift, diffusion, thermionic emission, tunnelling)
- Week 2 – PN junctions, MS Junctions
- Week 3 – MOS Capacitors
- Week 4 – MOS Capacitors
- Week 5 – Gate dielectrics
- Week 5 – Gate dielectrics
- Week 6 – Long Channel MOSFETs
- Week 7 – Long Channel MOSFETs
- Week 8 – Short Channel Phenomena
- Week 9 – Short Channel Phenomena
- Week 10 – Short Channel Phenomena
- Week 11 – Highly Scaled MOSFETs
- Week 12 – Highly Scaled MOSFETs
- Week 13 – Future Channel Materials
- Week 14 – Future Channel Materials
- Week 15 – Non-traditional MOSFETs

## **Prerequisite Knowledge**

Students should have taken an undergraduate level device physics course, and have a basic knowledge of band diagrams, current transport mechanisms, metal-semiconductor junctions, pn junctions, MOS capacitors, and MOSFETs/BJTs.

## **Evaluation Criteria**

Course grades will be based upon the following:

- Homework - 10%
- 2 Midterms - 50%
- Final - 40%

## **Reading Material**

Recommended (but not required) texts:

Fundamentals of Modern VLSI Devices – Yuan Taur, Tak Ning

Physics of Semiconductor Devices – S. M. Sze, Kwok Ng

## **Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is [\(213\) 740-0776](tel:2137400776).

## **Statement on Academic Integrity**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus*, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix

A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.