Fundamentals of Nanotransistors

Unit 1: Transistor Fundamentals

Lecture 1.1: Course Introduction

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Lundstrom: Nanotransistors 2015
Silicon MOSFETs

1960’s: $L \sim 10,000$ nm

(Source: Texas Instruments, ~ 2000)
Transistors

symbol

switch

amplifier

digital electronics

analogue electronics
Modern MOSFETs

Bulk Silicon MOSFET

Extremely Thin Silicon On Insulator (ETSOI) MOSFET

(Texas Instruments, ~ 2000)

(Source: IBM, 2009)
Modern MOSFETs: FinFETs

III-V FETs: HEMTs and MOSFETs

(after J. del Alamo, MIT)
Course objectives

1) Understand the physical operation of nanoscale transistors.

2) Relate that physical understanding to the IV characteristics.

(Source: Texas Instruments, ~ 2000)
Course outline

Unit 1: Transistor fundamentals

Unit 2: MOS electrostatics

Unit 3: The ballistic MOSFET

Unit 4: Transmission theory of the MOSFET

Prerequisite: Understanding of basic semiconductor physics.
Unit 1: Transistor Fundamentals

Lecture 1.1: Introduction
Lecture 1.2: The MOSFET as a Black Box
Lecture 1.3: MOSFET Device Metrics
Lecture 1.4: Transistors to Circuits
Lecture 1.5: Energy Band View of Transistors
Lecture 1.6: Traditional IV Theory
Lecture 1.7: The “Virtual Source Model”
Lecture 1.8: Unit 1 Summary

Please ask questions!
Additional resources

Links to relevant on-line resources will be provided.
(e.g. “Quick Review of Semiconductor Physics”)

A draft set of lecture notes to be published by World Scientific will also be provided to students of this course.

Please ask questions!