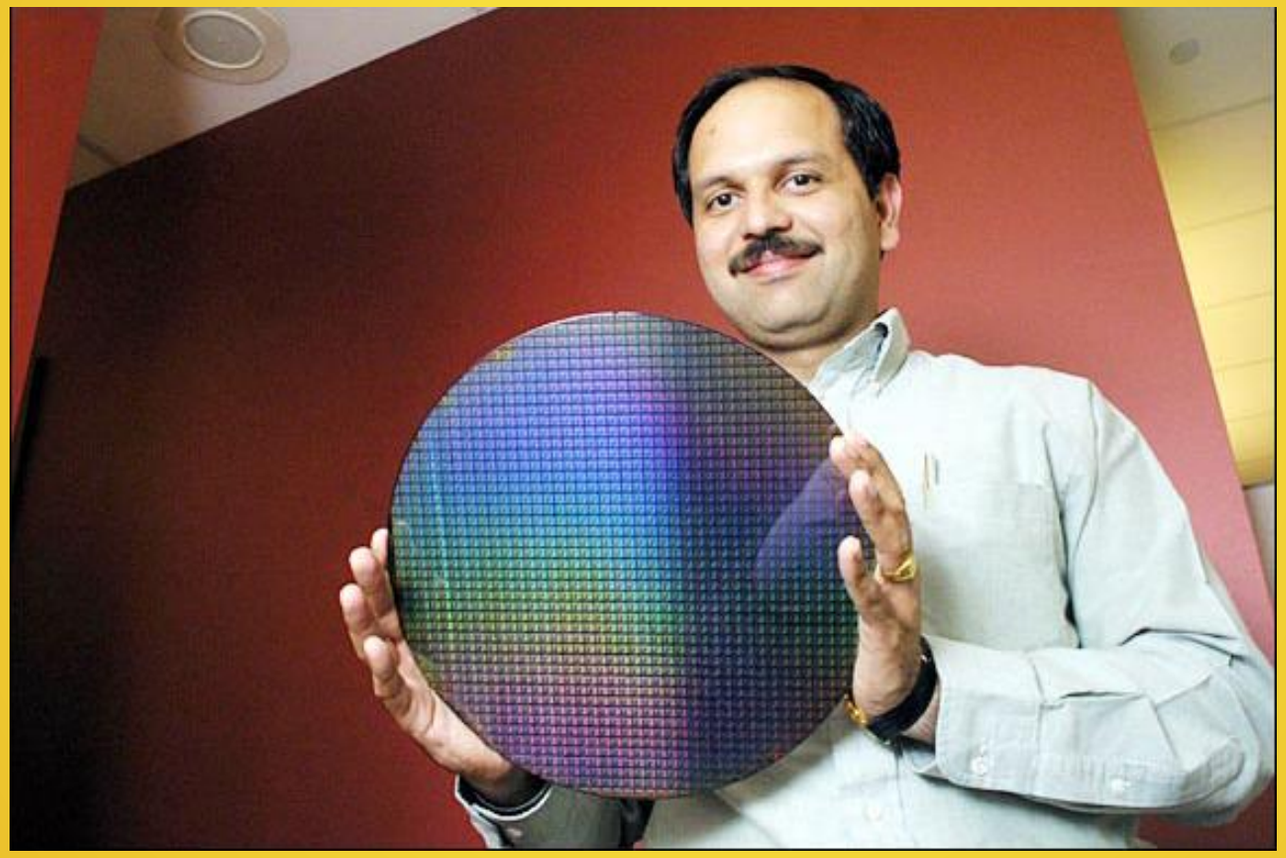
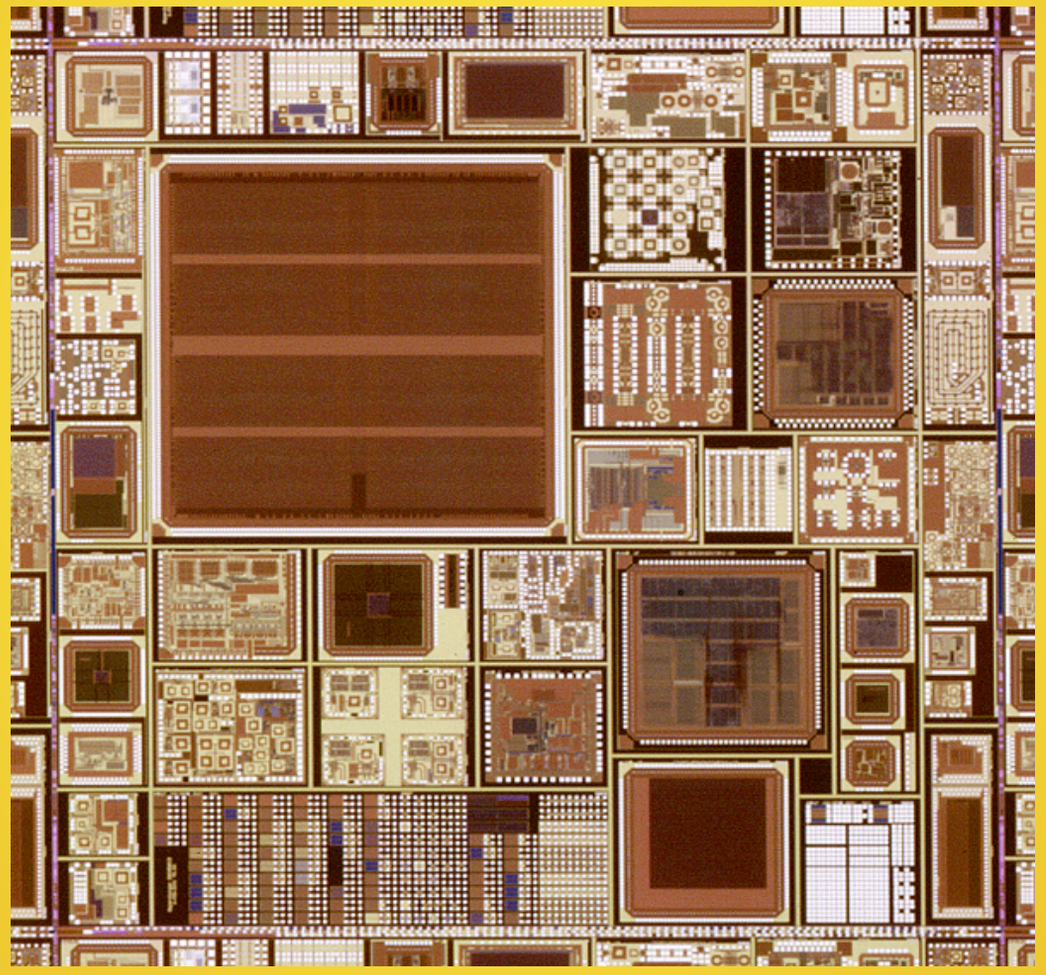
ELE 447/448 Digital Integrated Circuit Design I

IBM 300 mm Wafer



Former IBM 300 mm Foundry (GF)

MPW Reticle



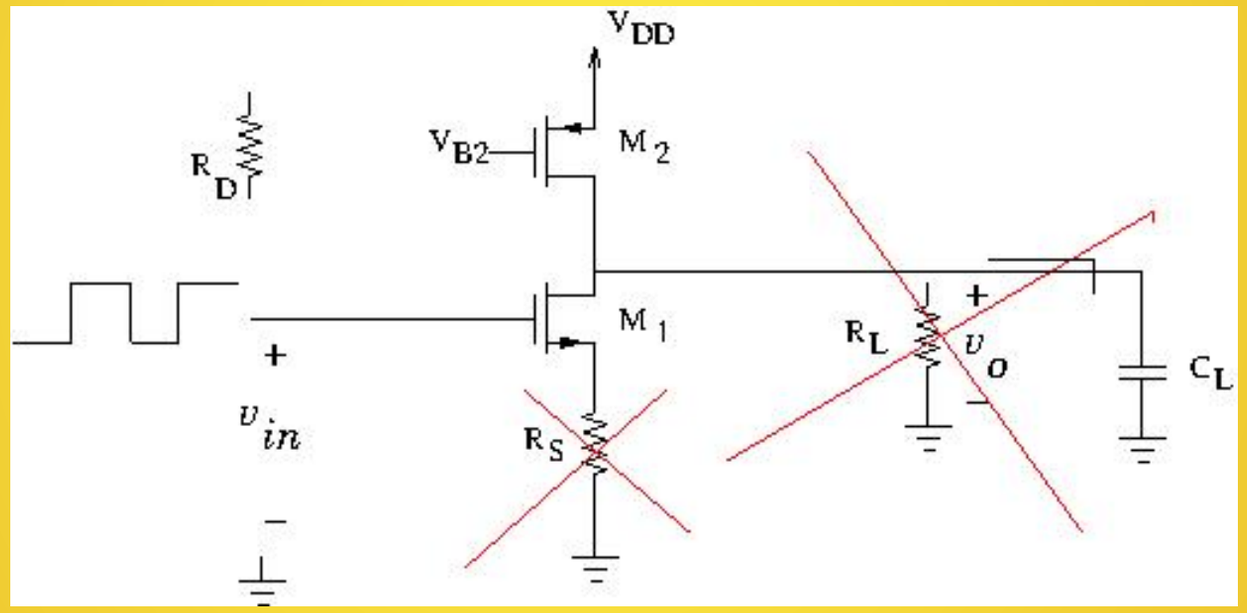
Course/Lab Description

- Full Custom Analog Integrated Circuit Design
- Synthesis of Systems Based Upon Hand Crafted Transistors
- Students Learn to Use CAD Tools
- Project Based Course

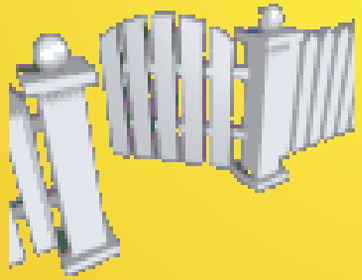
- Course Sequence:

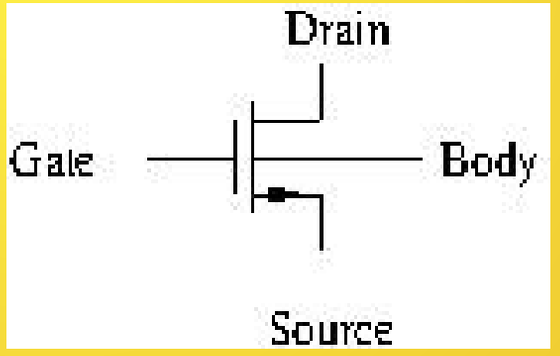
ELE 447/448 Digital IC Design I
ELE 537 Digital IC Design II
ELE 539 Analog IC Design
Additional Grad Courses in Microwave Design, etc.

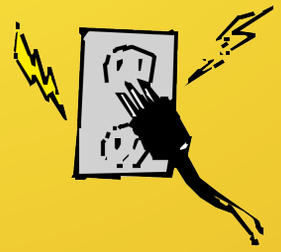
Use Pseudo nMOS & CMOS Inverters to Introduce Static Logic Families



We Will Need to Think About Device Physics/Models



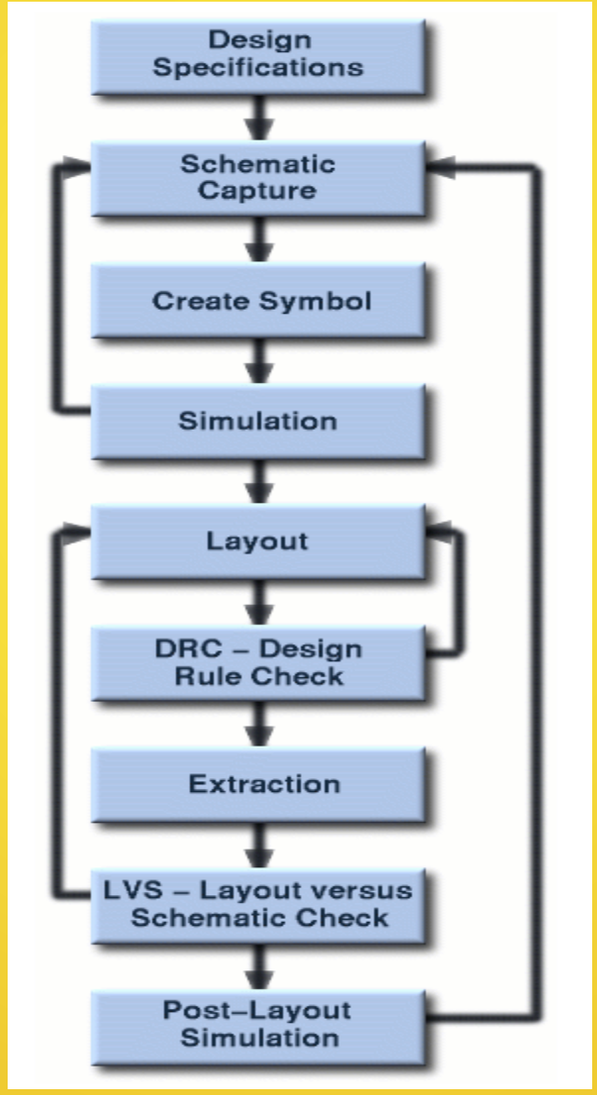




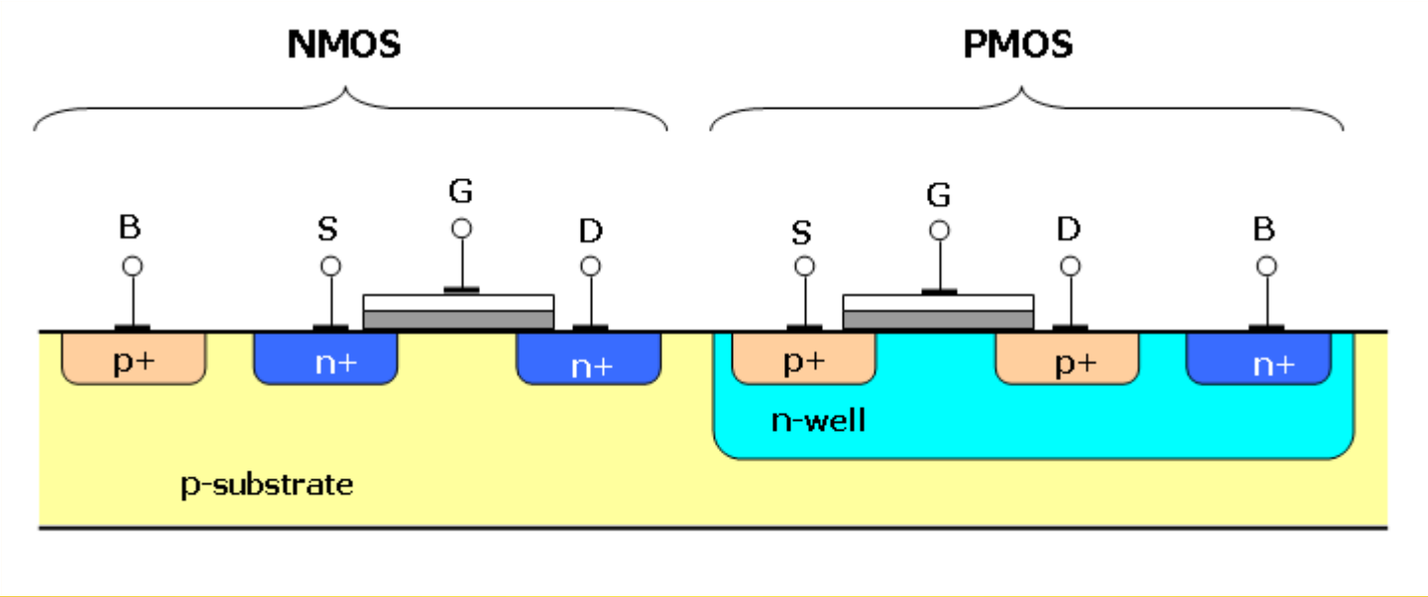
Topics

- Switch Models for MOS Transistor Analysis/Synthesis
- RC Models/Transient Response for Timing Analysis
- Understanding Device Physics → Designer's Point of View
- Device Technology Scaling and its Implications on a Designer
- Synthesis of Basic Gates to Building Blocks (e.g. Adders, Mux's, etc.) to Systems To an Entire IC
- Detailed Study/Analysis of High-Speed Cells (usually one type/family)
- Overview of Highlighted System/Project
- Logic Families: Static CMOS, Pseudo nMOS, Dynamic Logic
- Circuit Simulation Tools → HSPICE and Spectre
- Design Flow → Cadence/Mentor Graphics
- Layout
- Verification
- Manufacturability, Reliability, Yield

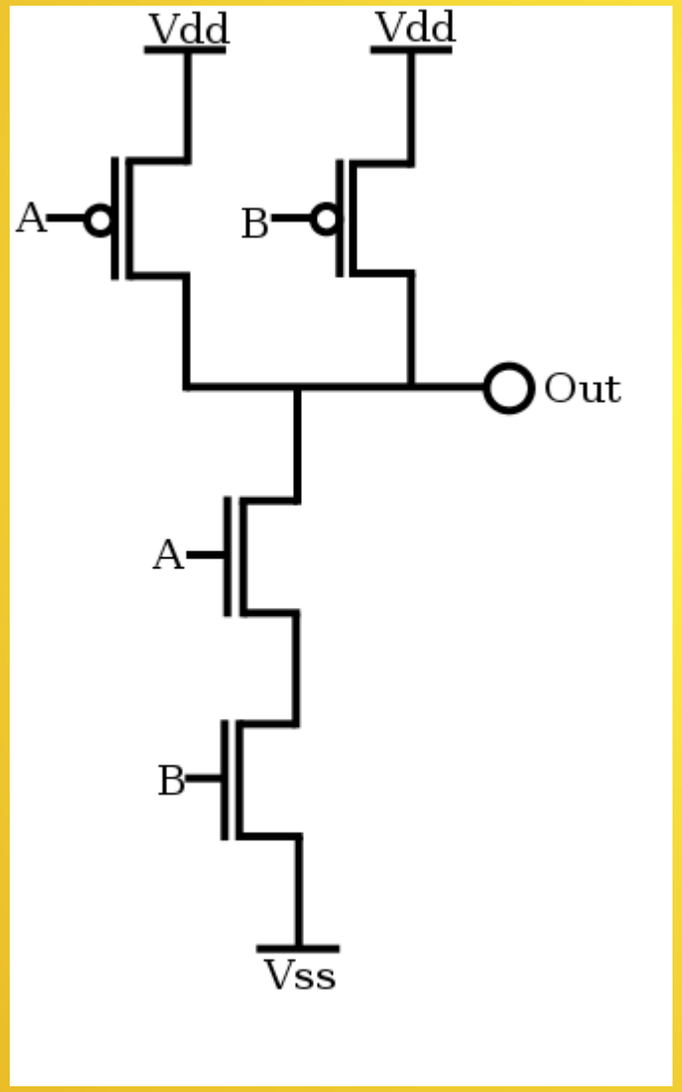
Design Flow

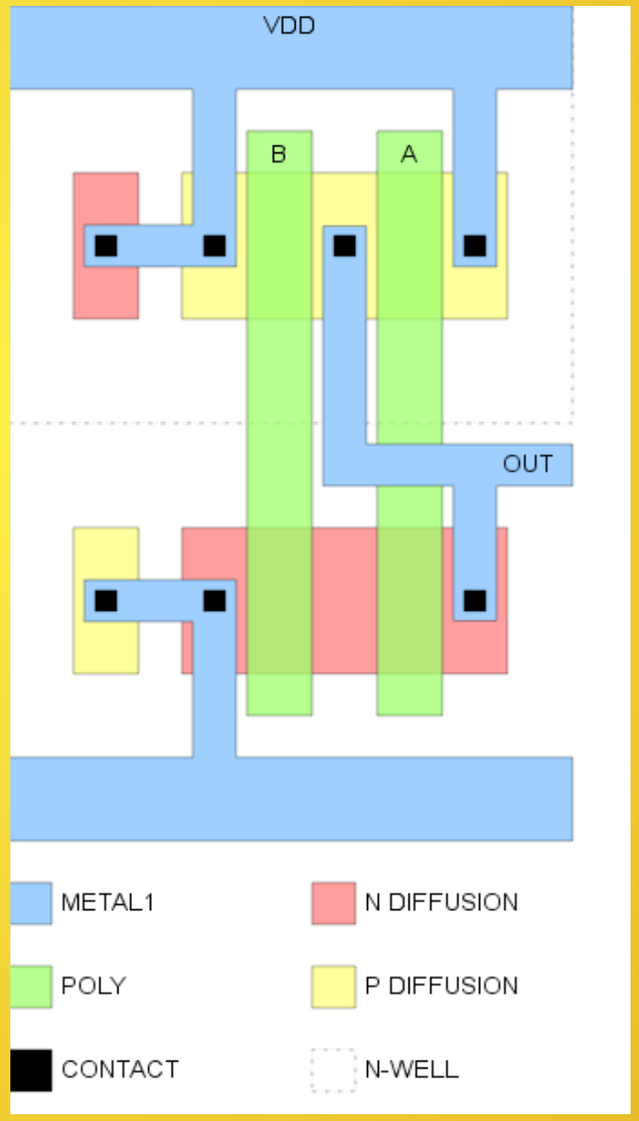

Design Specifications
Schematic Capture
Create Symbol
Simulation
Layout
DRC – Design Rule Check
Extraction
LVS – Layout versus Schematic Check
Post–Layout Simulation

Simplified CMOS Cross Section

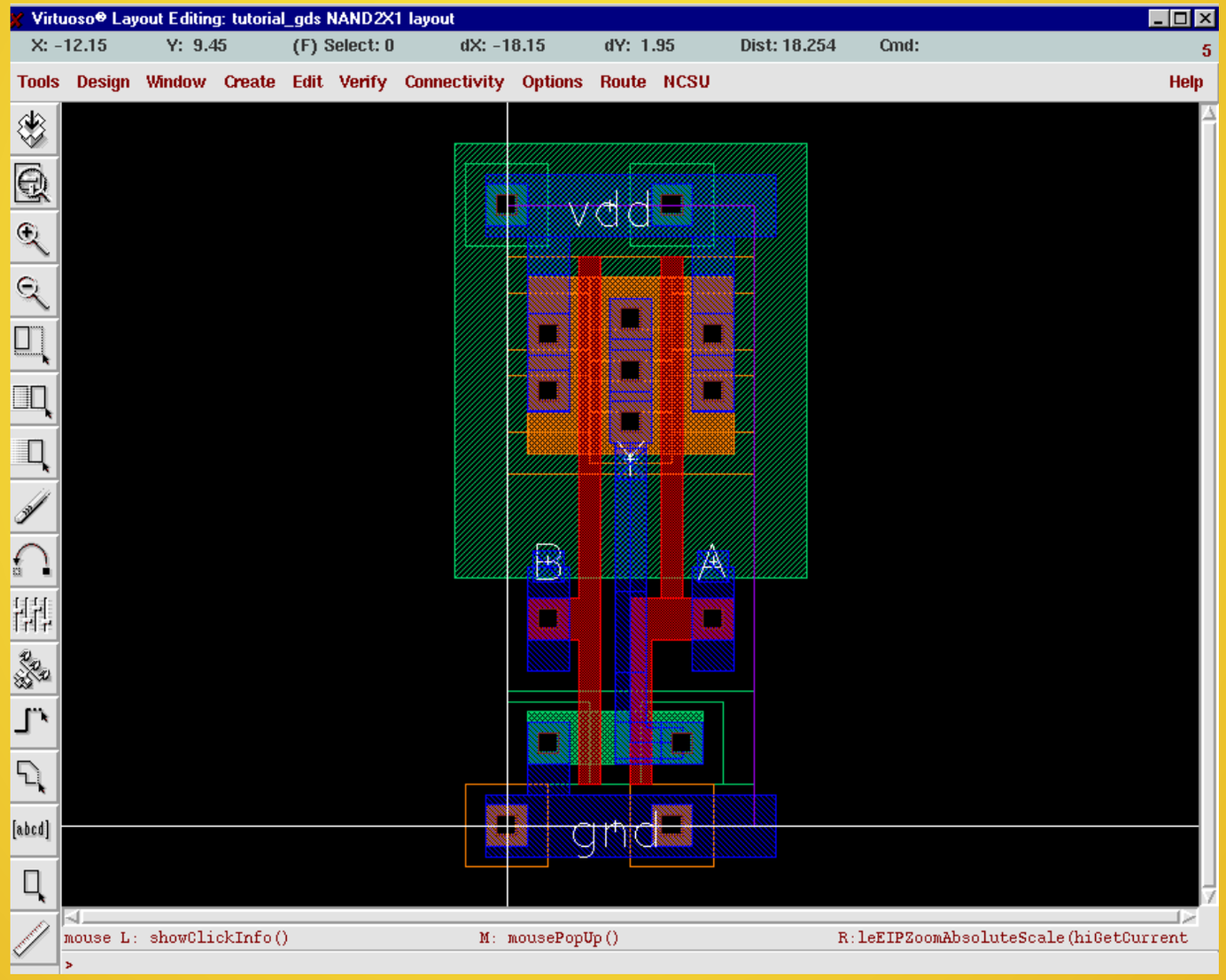


Example: Nand Gate

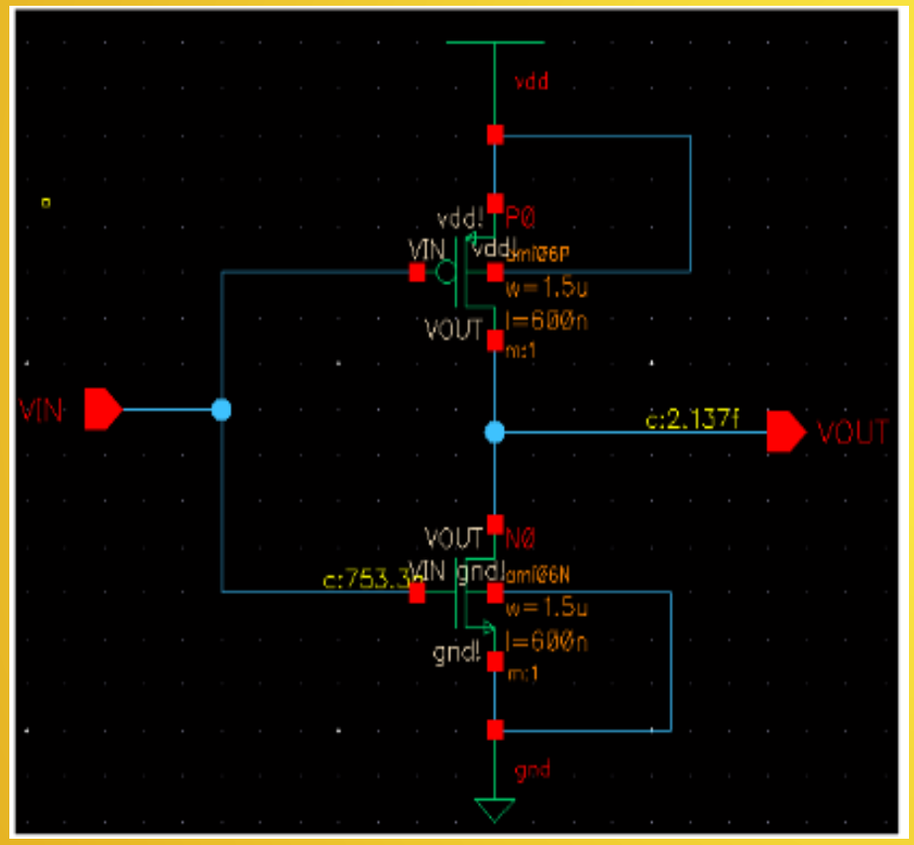


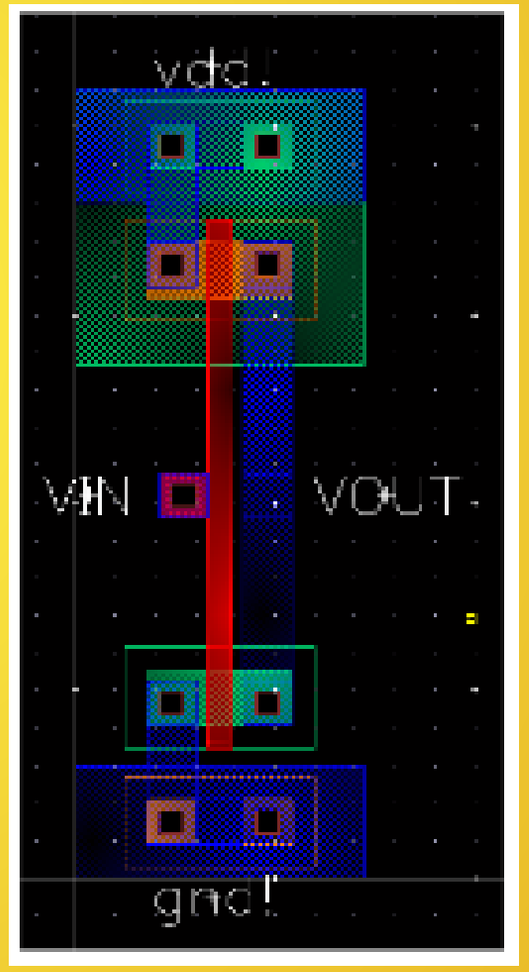


Virtuoso Layout of Nand2 Gate …

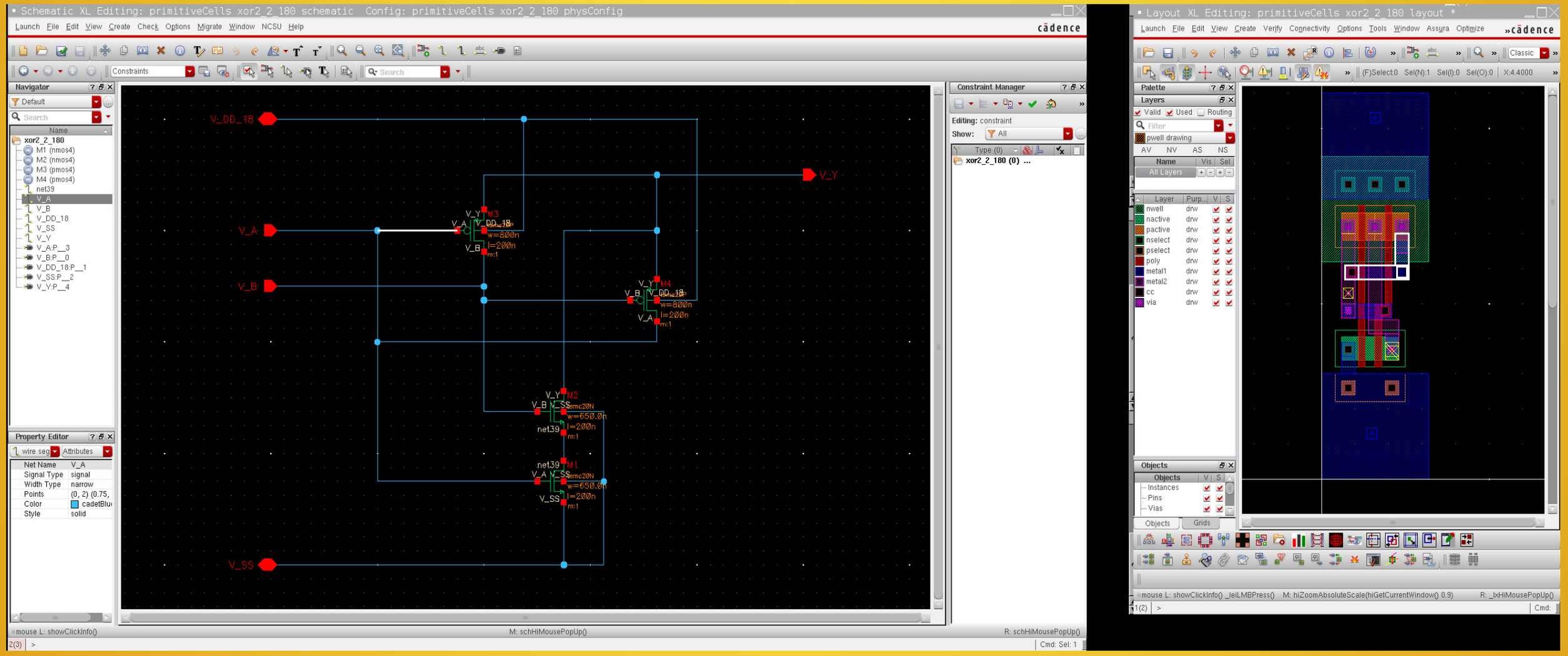


Virtuoso Schematic & Layout Example: Inverter

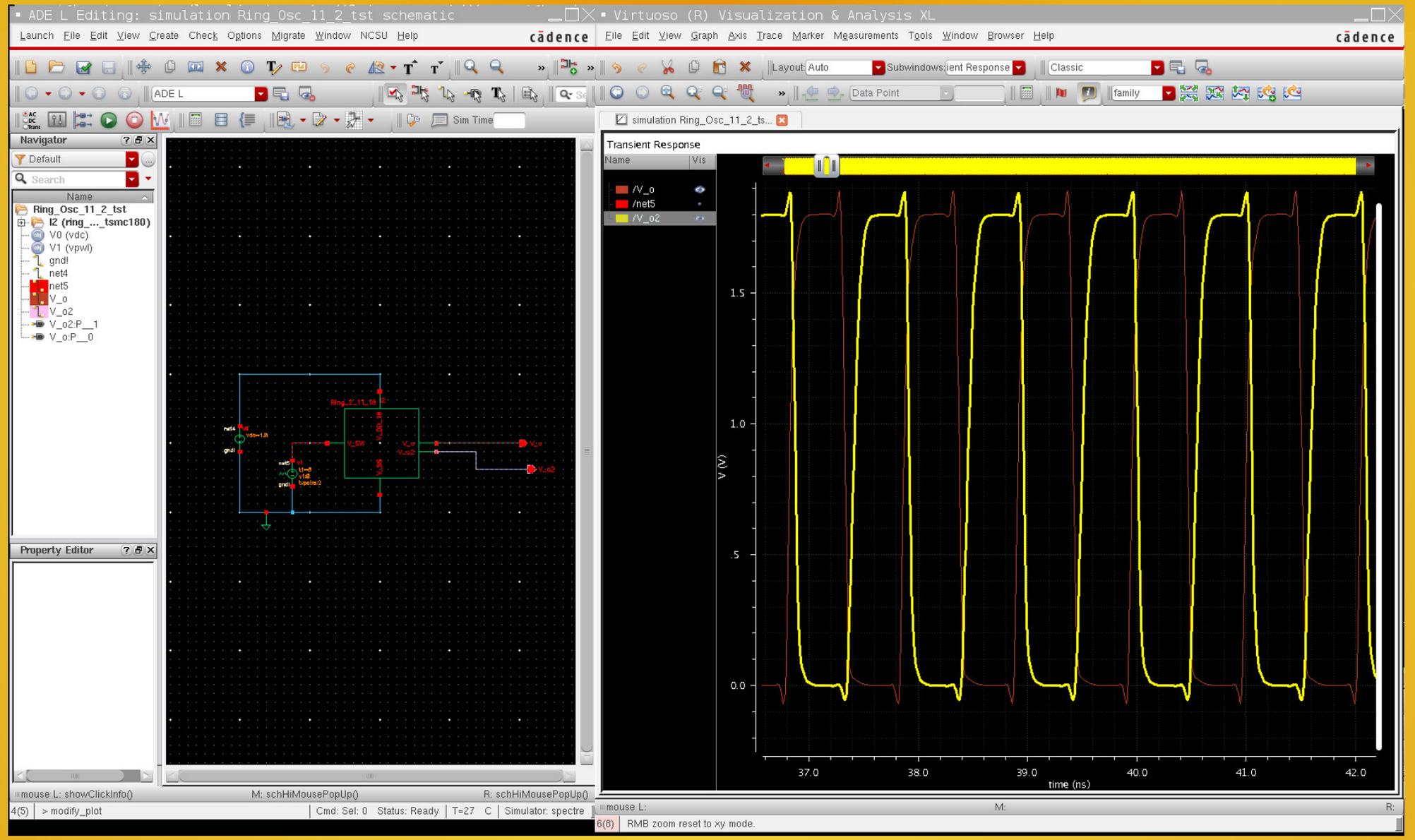




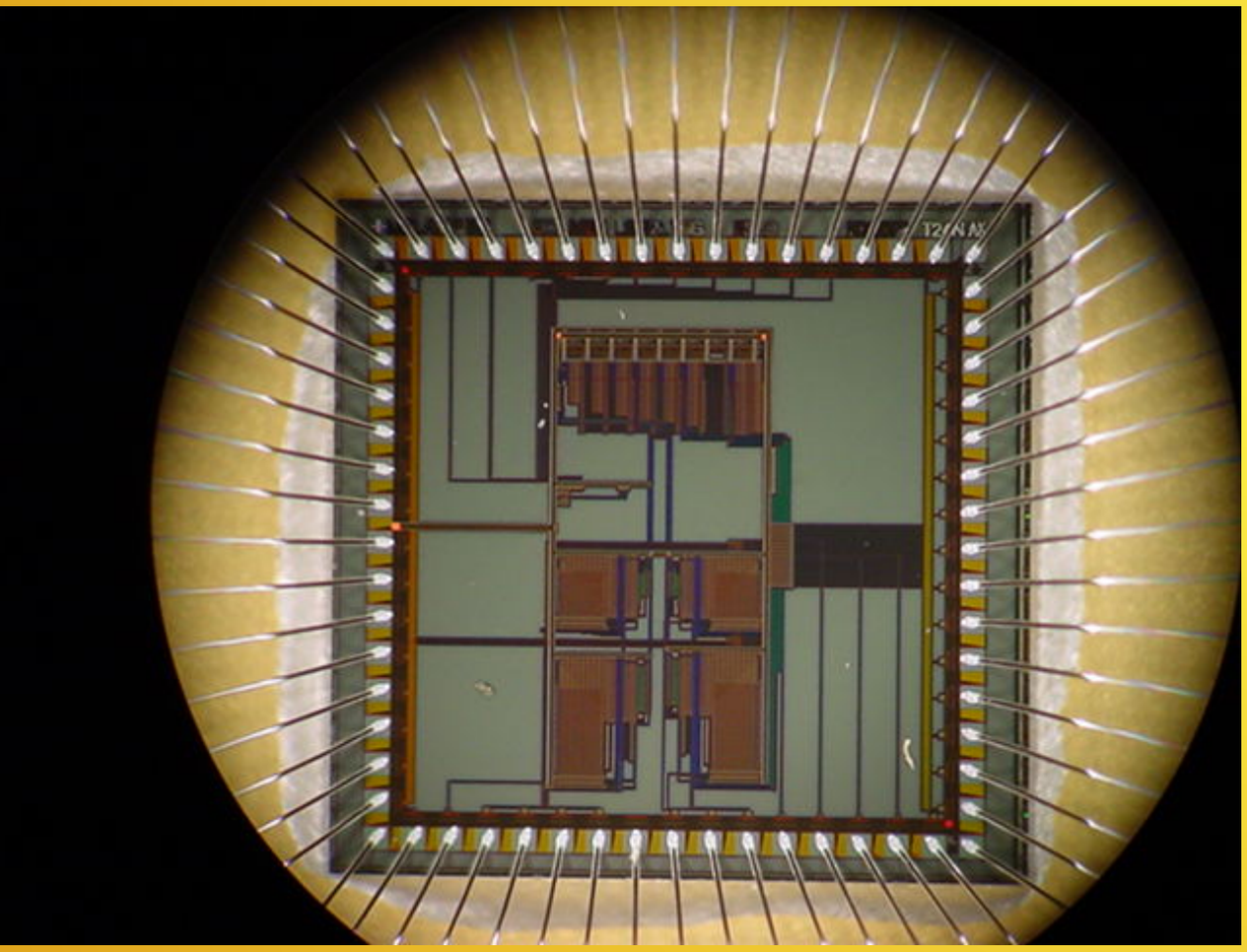
4 Transistor xnor Schematic & Layout

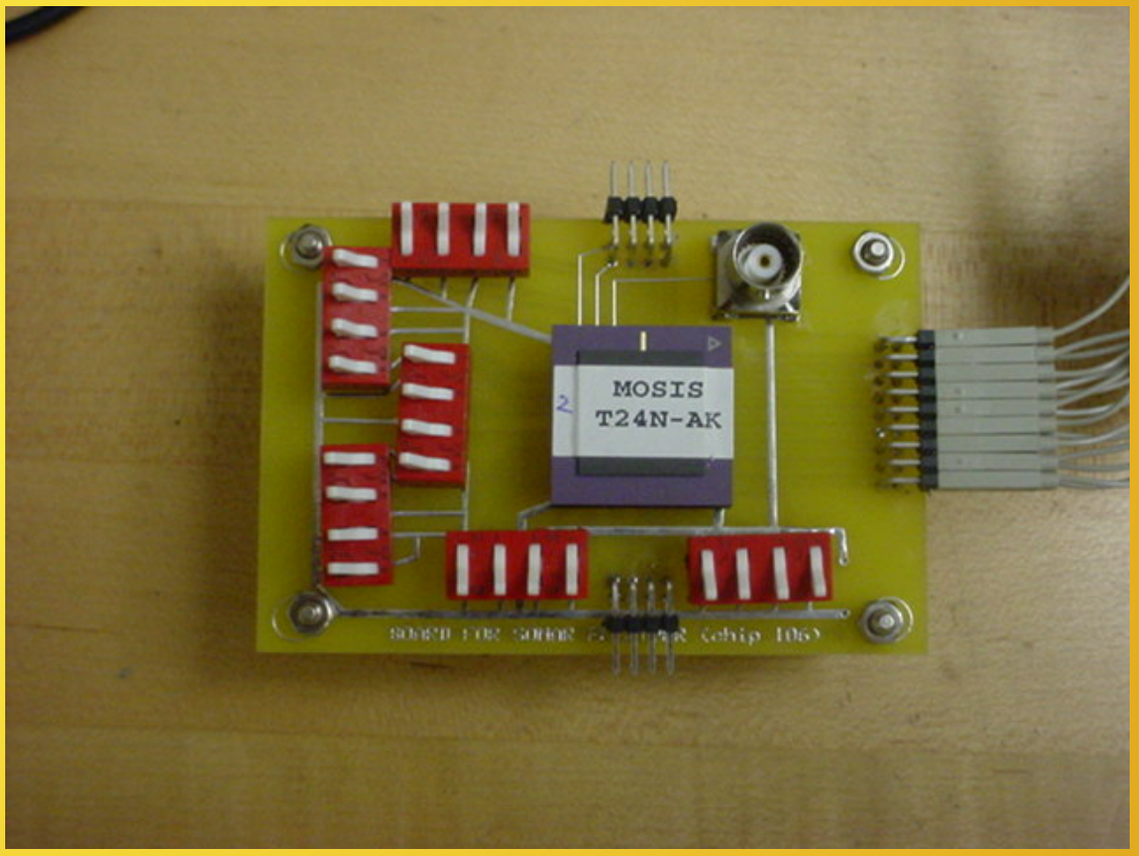


ADE Schematic Simulation



ICs Testing





Summary

- Project Based Course: Grading will be based upon a combination of Labs, Hwk, Exams and a Final Project

- Students are expected to understand basic circuit analysis, Emag and Electronics I

- A basic understanding of digital logic, e.g. gates, latches, flip-flops, counters, adders, etc. is also required