Lecture 12

• Last time:
  – pn junction *small-signal* capacitance
  – start MOS structure

• Today:
  – MOS charge storage
  – MOS capacitor

What Happens as $V_{GB}$ Increases?

Vertical $E$ field increases at the surface, lowering the barrier between the n-type region next to the gate and the channel underneath it …

eventually (at $V_{GB} = V_{Tn}$), electrons flood in and the surface of the substrate has an *inversion layer*
MOS Capacitor in Inversion

Charge vs. Voltage Curve
N-Type Substrate Case

MOS Capacitance vs. Voltage

\[ V_{FB} \quad V_{TH} = 0.6 \text{ V} \]
MOSFET Concept

Add 4th terminal to MOS capacitor:

lateral current carried by inversion charge →
controlled by gate

advantages: no DC control power required, relatively simple to fabricate
MOSFET Cross Section

Modern MOSFET Cross Section
MOSFET “Analog” Symbols

n-channel MOSFET

p-channel MOSFET