EE5390 - Analog IC Design

Jan - Apr 2012

Note Title

02-01-2012

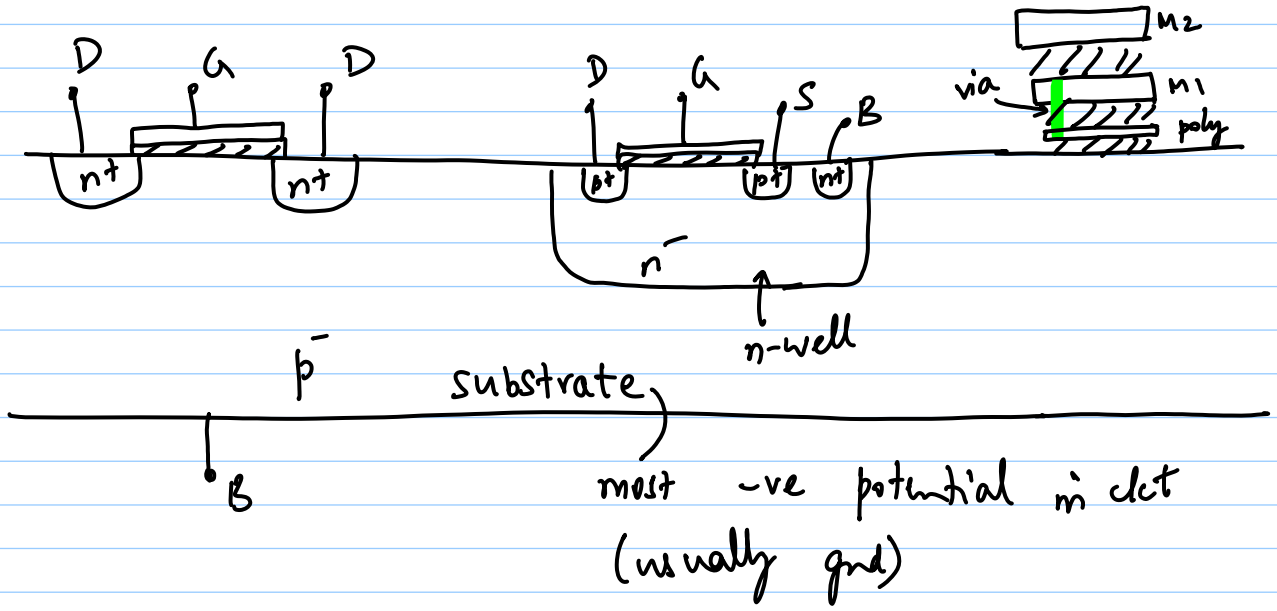
Class hrs : Tu - 11-11:50am
W - 10-10:50am
Th - 8-8:50 am
F - 2:55-3:45pm

Textbook : Design of Analog CMOS Integrated Circuits
- Behzad Razavi
Tata Mc Graw Hill 2006

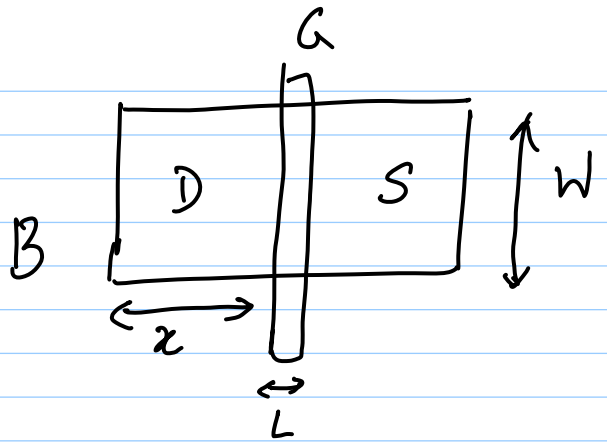
Grading : HW, Projects - 30%.
Quiz 1 & 2 - 15% each
Final Exam - 40%.

Prereq. : EC 3102 / EC5135

3/1/12 Lec 1 - CMOS ICs



* nmos - p-sub
* pmos - n-well



top view

where is B node?

what devides x?

Resistors : polysilicon, n-well, n^+, p^+, metal, MOS in triode region

$\Omega/\square$ $K\Omega/\square$ $100^s\Omega/\square$ $m\Omega/\square$

e.g. Poly-Si

$$R = \frac{\rho L}{t \cdot W} = R_{sh} \cdot \frac{L}{W}$$

R_{sh}: sheet resistance

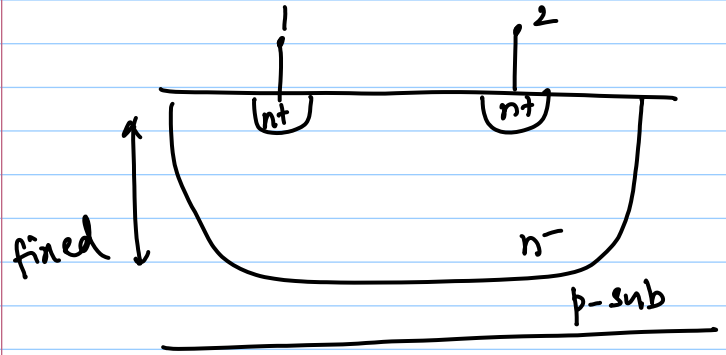
few $\Omega/\square$ to few $100\,\Omega/\square$

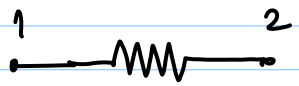
→ choose R based on –

top-view

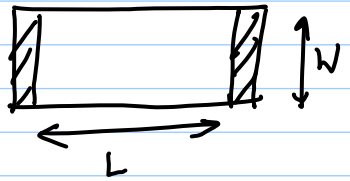
* R_{sh}
* temp
* nonlinearity

n-well resistors

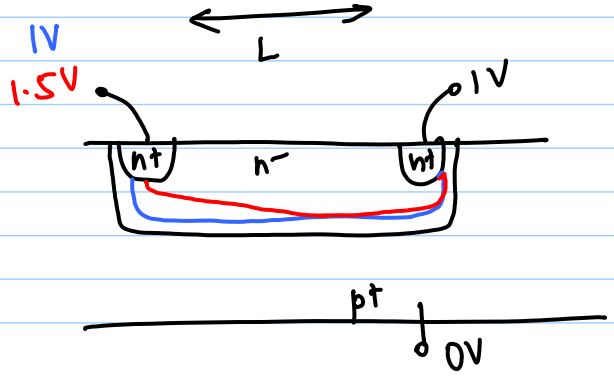


$\equiv$ 

R_{sh} = few kΩ/□ {∵ n^-}

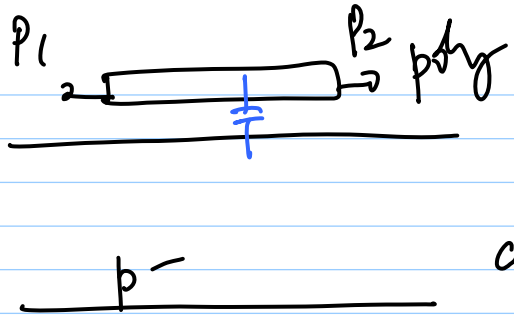


$R = R_{sh} \cdot \left(\frac{L}{W}\right)$

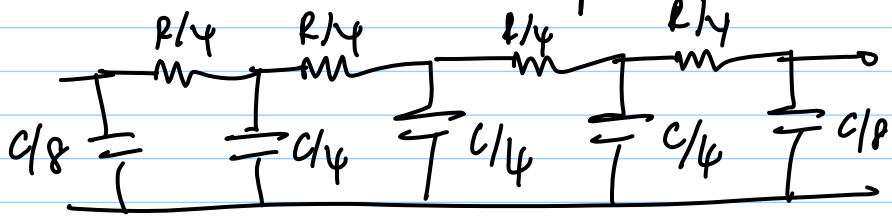


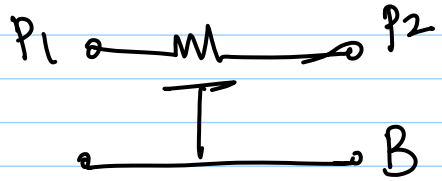
* nwell - psub depletion region width = f(v) {non linear}

$\Rightarrow I = \frac{V}{R} + \alpha_2 V^2 + \alpha_3 V^3 + \cdots$



distributed cap

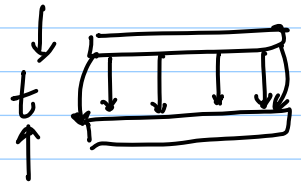




Caps : → metal – oxide – metal (linear)

→ MOSFET cap (non-linear, dense)

MOM



MOM cap (parallel plate)

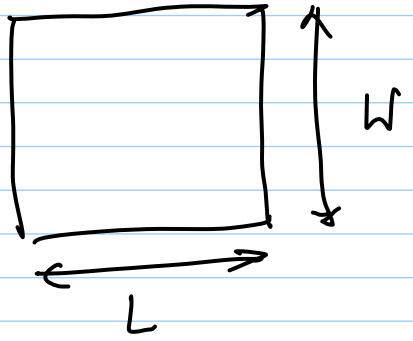
$$C = \epsilon \frac{WL}{t} = C'(WL)$$

↑ cap / unit area

e.g. $fF/\mu m^2$

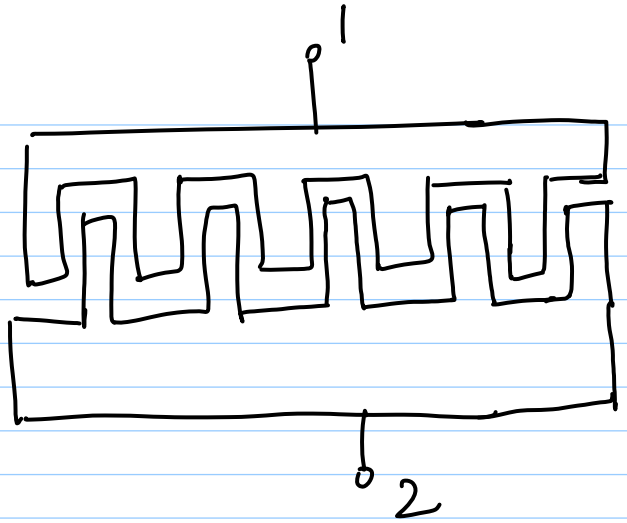
low density

top view

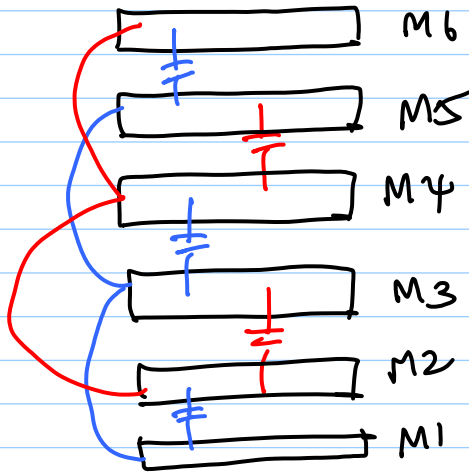


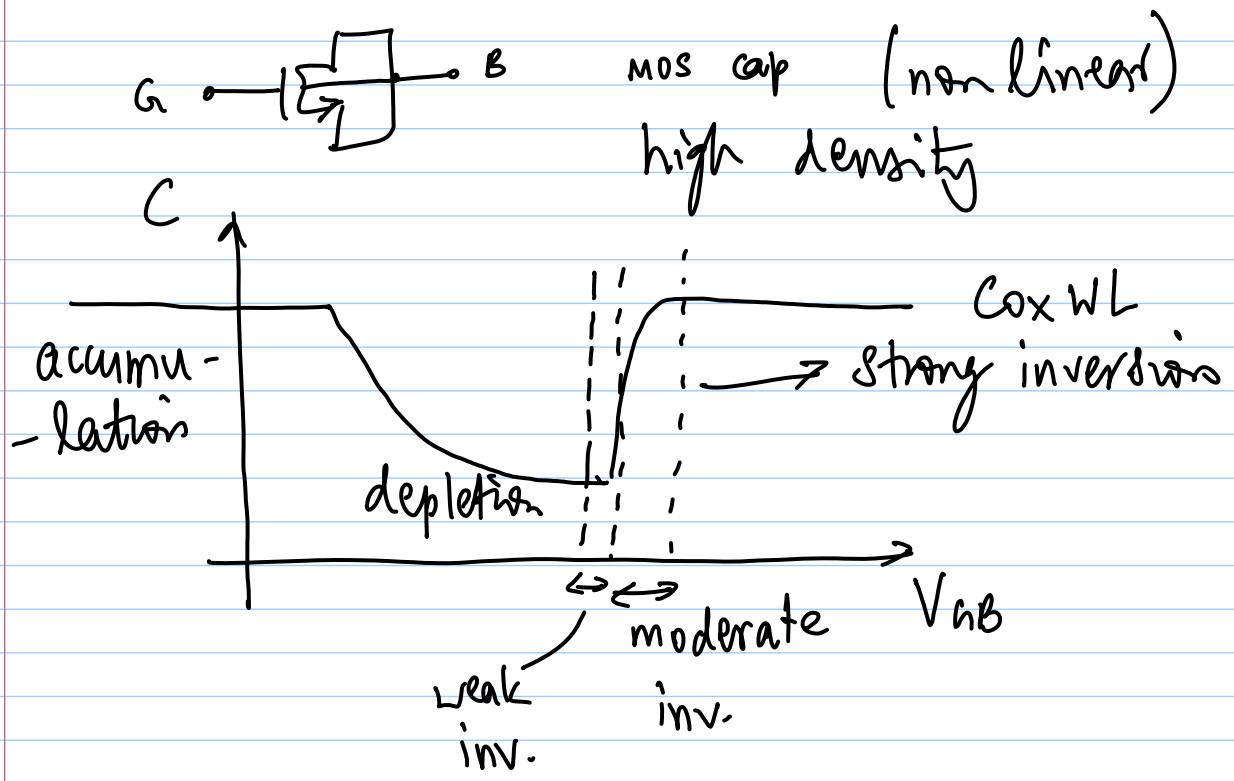
increase density :

1) Comb structure



2) Multilayer





typically $C_{MOS} \sim 2\text{-}3 \times C_{MOM}$ for given area

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Process node — 0.25μm, 0.18μm, 0.13μm ...

= min. L of MOSFET

e.g. 0.18μm process ⇒ $L_{min}|_{MOS} = 0.18\mu m$

* min. limit to all dimensions ($\neq L_{min}$)
* limited by photolithography