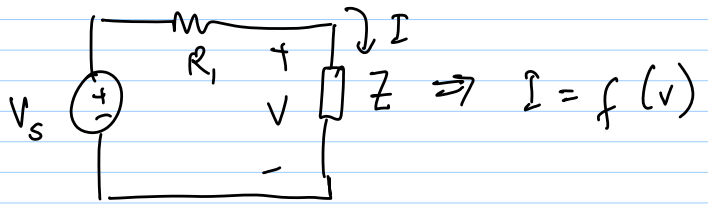


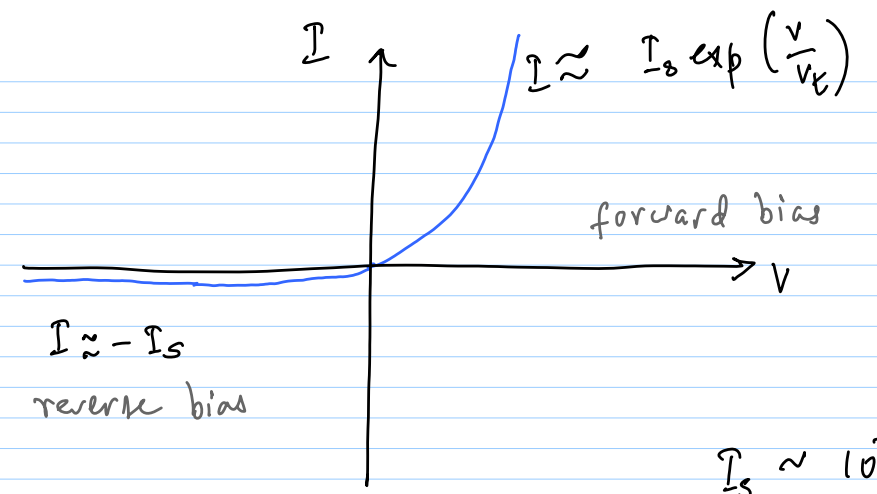
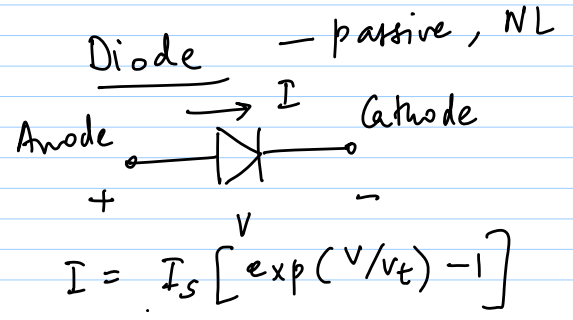
20/2/15

Lec 18

Non linear Ckts



$I = \frac{V_s - V}{R_1}$   
 $I = f(V)$



$I = I_s \left[ \exp\left(\frac{V}{V_t}\right) - 1 \right]$

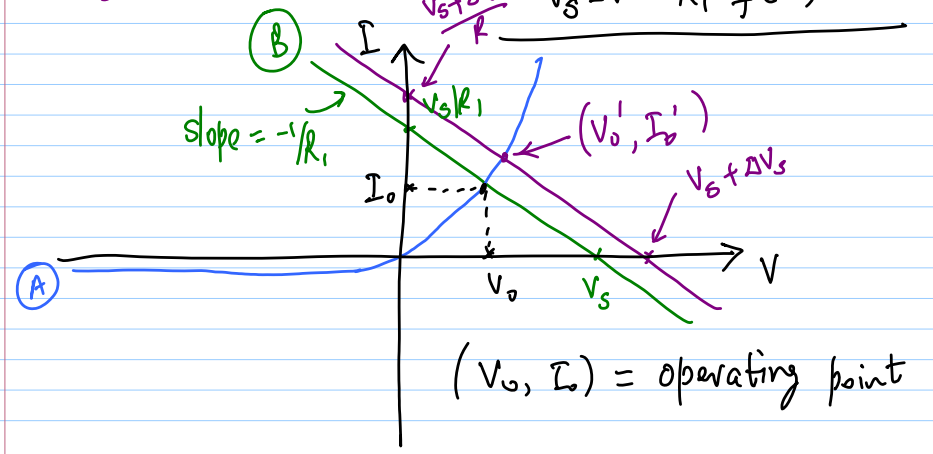
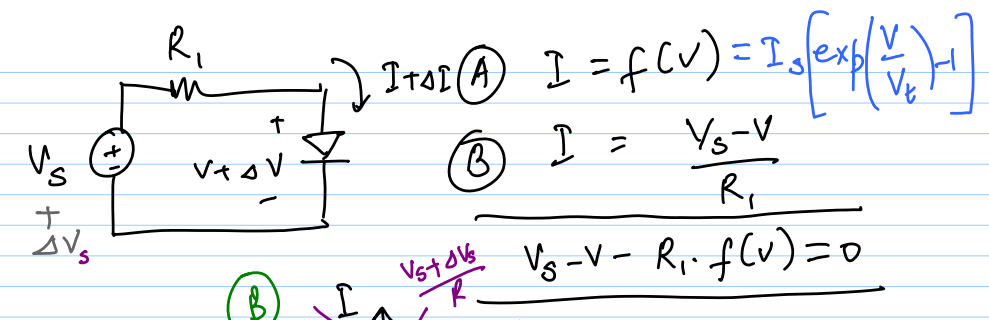
$I_s \sim 10^{-15} \text{ A}$   
 $V_t = \frac{kT}{q}$

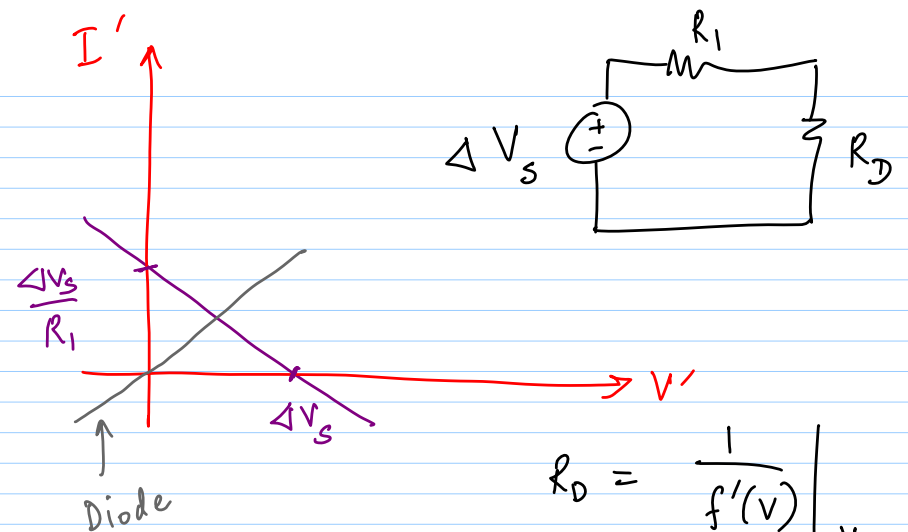
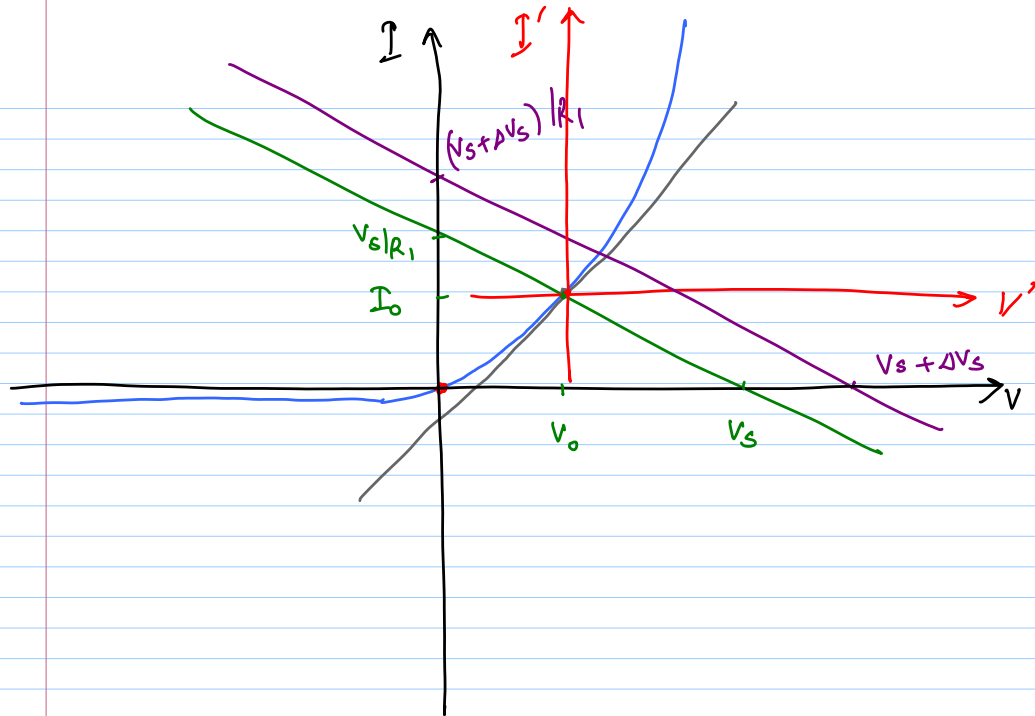
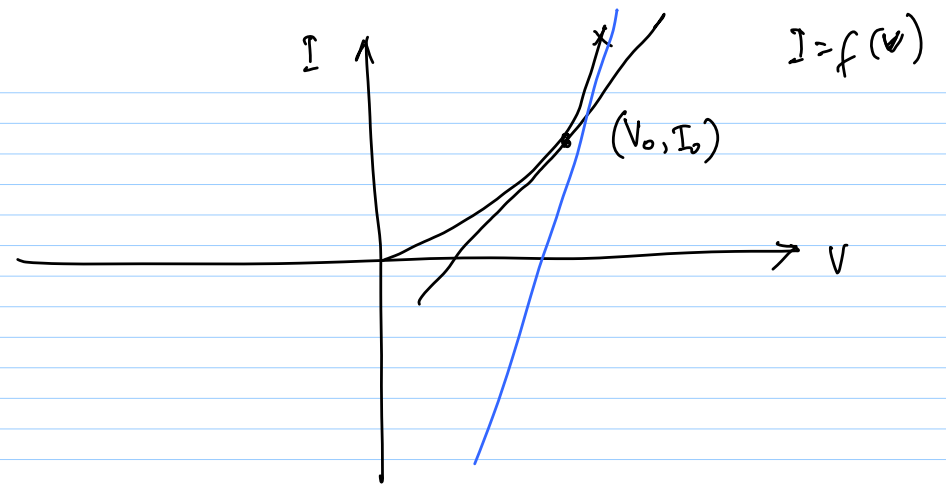
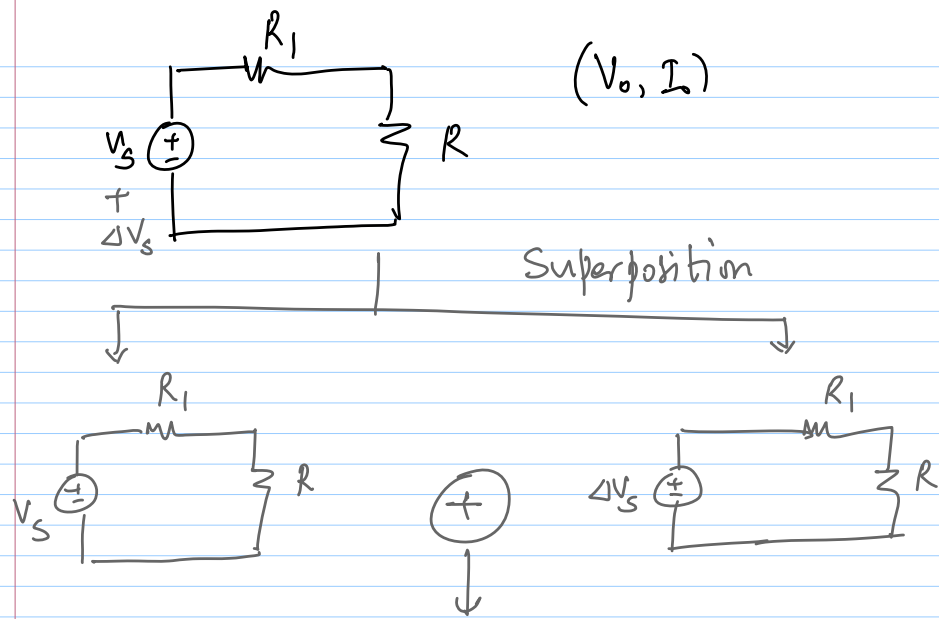
$I_s$  = saturation current  
 $V_t$  = thermal voltage

$= \frac{kT}{q}$  ← absolute temp. (K)  
 ← electron charge

Boltzmann's constant  
 $1.38 \times 10^{-23} \text{ J/K}$

@ RT (300K) :  $V_t \approx 25.9 \text{ mV}$   
 $\approx 25 \text{ mV}$   
 $\approx 26 \text{ mV}$





$\Delta V_S = \text{increment}$

$R_D = \text{incremental resistance of diode (dynamic)}$