EE 420 / ECG 620
Analog IC Design

Lecture 26, May 8, 2018

$$I_{D1} = I_S e^{V_{D1}/nV_T}, \quad I_{D2} = kI_S e^{V_{D2}/nV_T}$$

$$V_{D1} = nV_T \ln \frac{I_{D1}}{I_S} \qquad V_{D2} = nV_T \ln \frac{I_{D2}}{kI_S}$$

$$I_{D1} = \frac{V_{REF} - V_{D1}}{L \cdot R}$$

$$I_{D2} = \frac{V_{REF} - V_{D2}}{L \cdot R + R}$$

$$I_{D1} = I_{D2}$$

$$\frac{V_{REF} - V_{D1}}{L \cdot R} = \frac{V_{REF} - V_{D2}}{LR + R}$$

$$V_{REF} - V_{D1} = \frac{LR}{LR+R} \cdot (V_{REF} - V_{D2})$$

$$X$$

$$V_{REF}(1 - X) = V_{D1} - XV_{D2} = K$$

$$= N\frac{KT}{q} N \ln \frac{I}{I_S} - X \frac{KT}{q} \cdot N \ln \frac{I}{KI_S}$$

$$\ln \frac{a}{b} = \ln c - \ln b \quad = \frac{NKT}{q} \ln \frac{I}{I_S} \left(1 + X \ln K\right)$$

2)

$$V_{REF} = I \cdot LR + I \cdot R + V_{D2}$$

$$V_{REF} = V_{REF} - V_{D1} + \frac{V_{REF}}{RL} - \frac{V_{D1}}{L} + V_{D2}$$

$$\frac{V_{REF} - V_{D1}}{LR} = I$$

$$0 = -V_{D1} \cdot L + V_{REF} - V_{D1} + L \cdot V_{D2}$$

$$V_{REF} = V_{D1} + L(V_{D1} - V_{D2})$$

$$= V_{D1} + L\frac{KT}{q}\ln K$$