

ECE 523/421 – Analog Electronics

Lecture 17: Frequency Response: High-frequency Device Models

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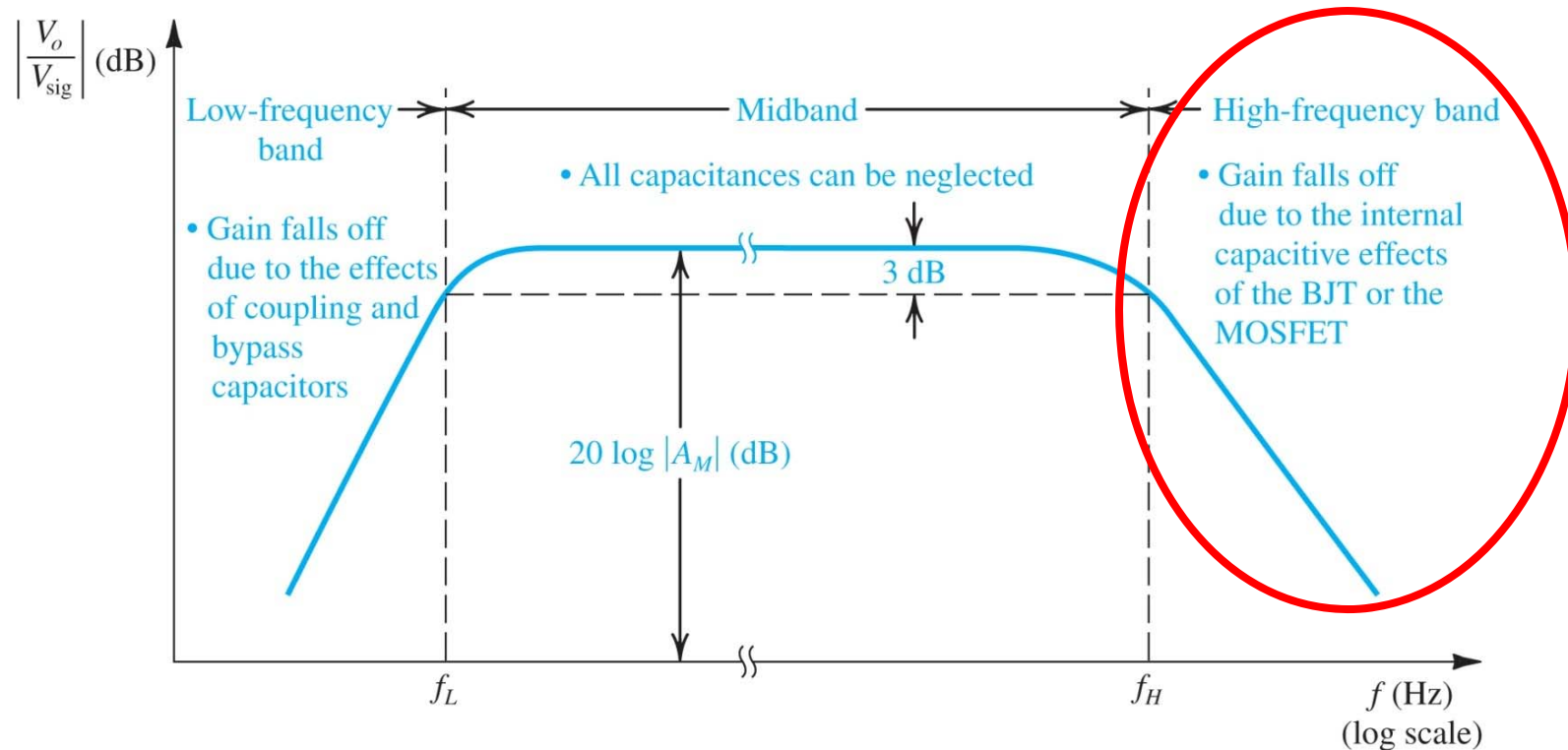
Review of Last Lecture

- ☐ Estimation of lower 3dB frequency in CS amplifier
- ☐ Estimation of lower 3dB frequency in CE amplifier

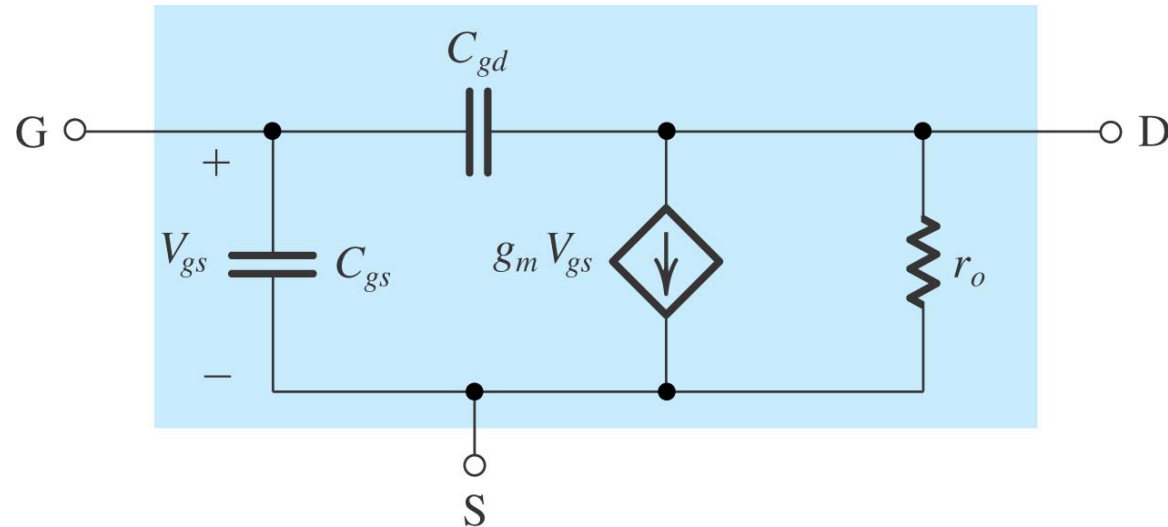
Today's Lecture

- ❑ MOSFET parasitic capacitance effect
- ❑ BJT parasitic capacitance effect
- ❑ Definition of unity gain frequency f_T

Frequency Response of a typical Amplifier



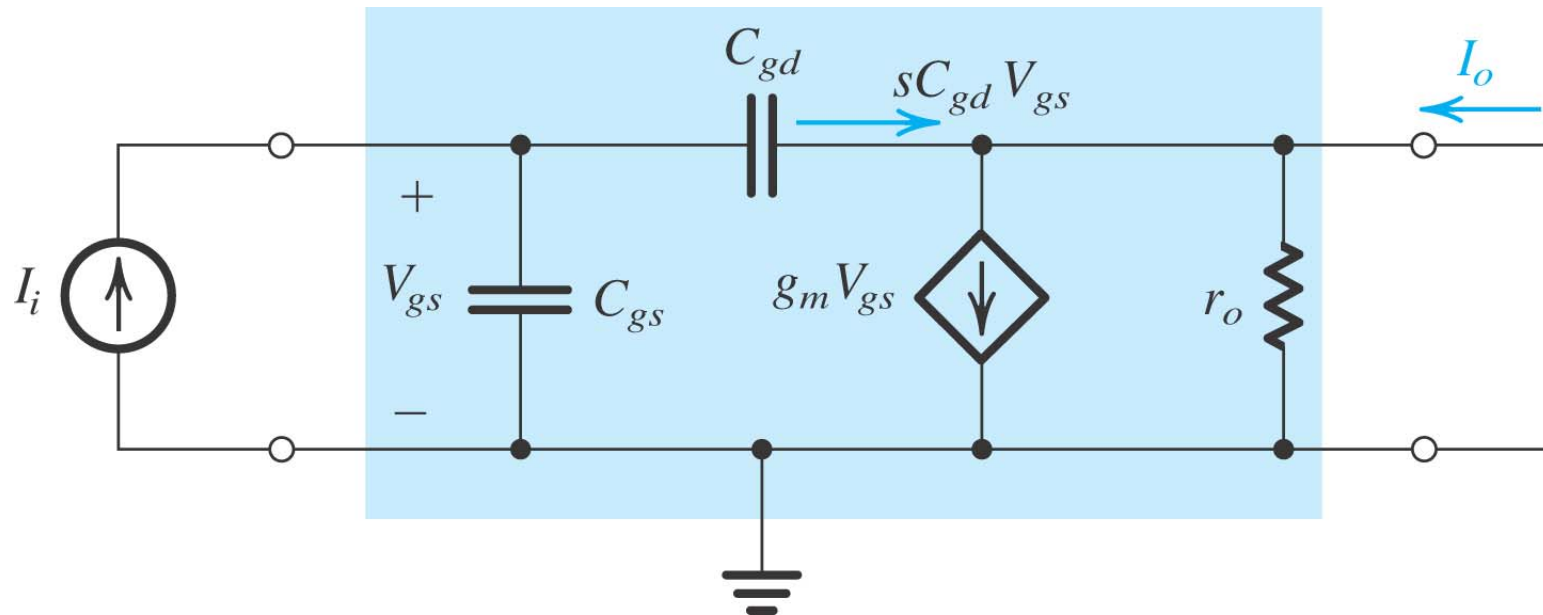
Simplified High Frequency of MOSFET



$$C_{gd} \approx C_{ov} = WL_{ov} C_{ox}$$

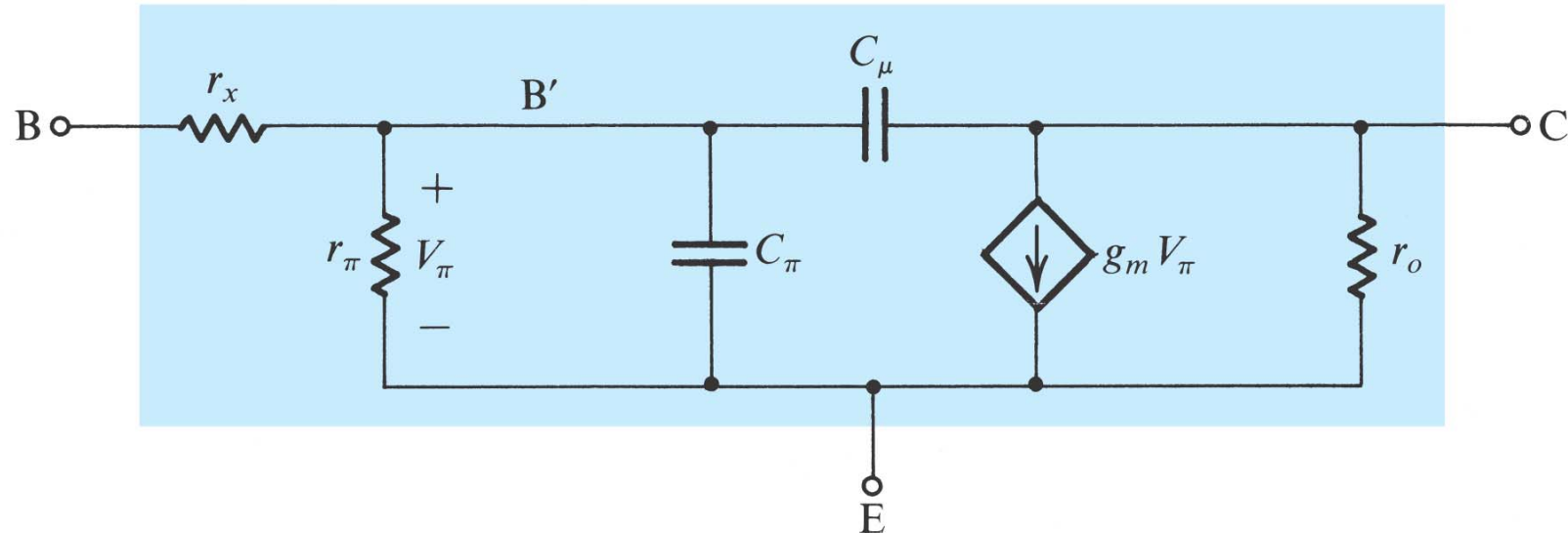
$$C_{gs} \approx C_{ov} + C_{ch} = WL_{ov} C_{ox} + \frac{2}{3} WLC_{ox}$$

Unity-Gain Frequency in MOSFET



$$\left| \frac{I_o}{I_i} \right| = 1 \quad \Rightarrow \quad f_T \approx \frac{g_m}{2\pi(C_{gs} + C_{gd})}$$

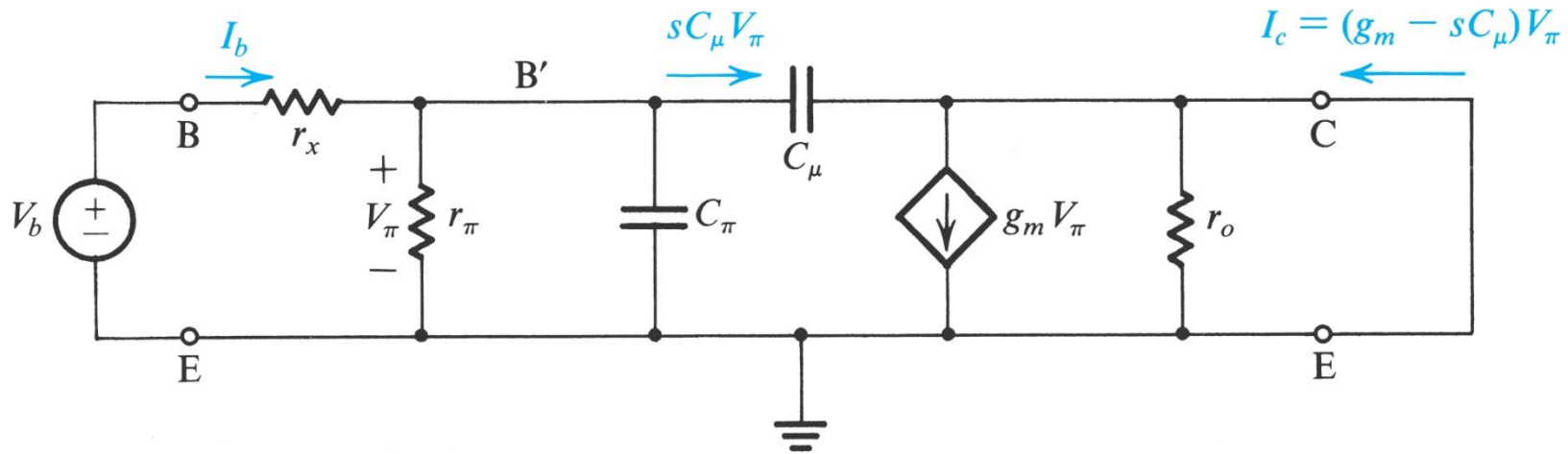
Simplified High Frequency of BJT



$C_\mu = CB$ Junction Capacitance

$C_\pi = BE$ Junction Capacitance + B Charging Capacitance

Unity-Gain Frequency in BJT



$$\left| \frac{I_c}{I_b} \right| = 1 \quad \Rightarrow \quad f_T \approx \frac{g_m}{2\pi(C_\pi + C_\mu)}$$