Elektronik II

Aktif yüklü fark yükselteci ve frekans cevabı

Orijinal not: Ders8.pdf

UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

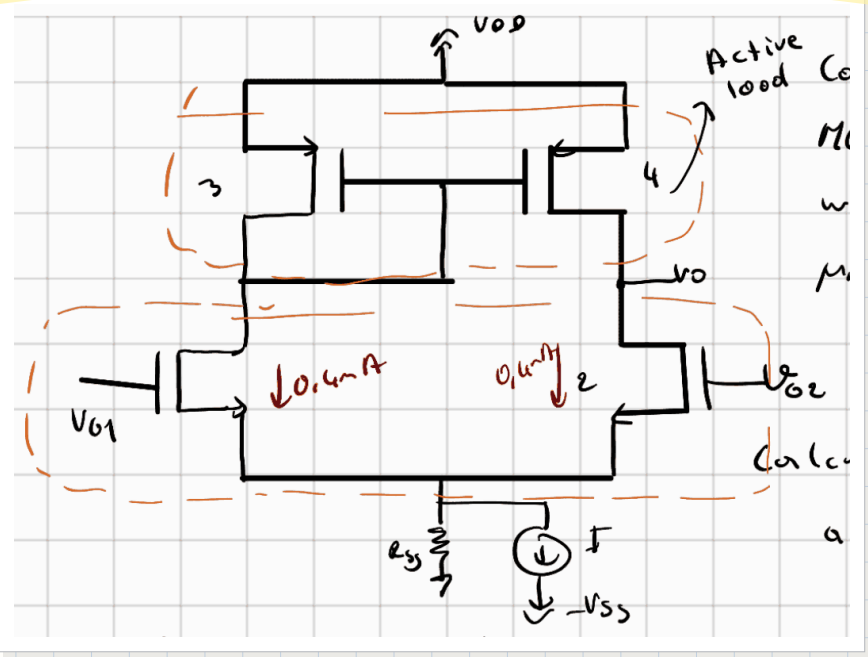
NOTICE *This document was transcribed from handwritten lecture notes with the help of Claude (Anthropic). It is meant as a supplementary resource and may contain errors or omissions. Always check against the original notes and official course material.*

orj. s. 1

Örnek 7

Consider the active loaded MOS differential amplifier with $(W/L)_n = 100$, $(W/L)_p =$? okunamadı, $\mu_n C_{ox} = 2\mu_p C_{ox} = 0{,}2$ mA/V^2, $|V_A|_n = |V_A|_p = 20$ V, $I = 0{,}8$ mA, $R_{SS} = 25$ kΩ. Calculate g_m, R_o, $|A_d|$, $|A_c|$ and CMRR[a]

[a] Claude notu: Soru metni sayfa kenarında kesilmiş; "loaded", "amplifier", "mA/V^2" ve "$|A_c|$" tamamlanmıştır.



orijinal çizim, s. 1

Çözüm: $g_{m1,2} = ?$ $\rightarrow$ $\dfrac{2(0{,}4)}{V_{OV} = 0{,}2} = 4$ mA/V

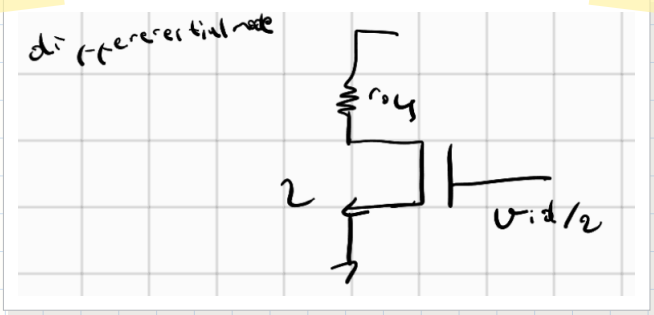
$$0{,}4 = \tfrac{1}{2} \cdot 0{,}2 \cdot 100\,(V_{OV})^2 \quad \Rightarrow \quad 0{,}04 = (V_{OV})^2 \Rightarrow V_{OV} = 0{,}2$$

$R_{SS} = 25$ kΩ

$r_{o1,2} = \dfrac{V_A}{I_D} = \dfrac{20}{0{,}4} = 50$ kΩ

$r_{o3,4} = r_{o1,2} = 50$ kΩ

differential mode



orijinal çizim, s. 1

$$= g_m (r_{o4} \parallel r_{o2})$$
$$= \frac{1}{2} g_m r_o = \frac{1}{2} \cdot 4\ \text{mA/V} \cdot 50\ \text{k}\Omega$$
$$= 100\ [\text{V/V}]$$

$$A_{cm} = \frac{1}{2 g_m R_{SS}} = \frac{1}{2 \times 4\ \text{mS} \times 25\ \text{k}\Omega} = \frac{1}{200}$$

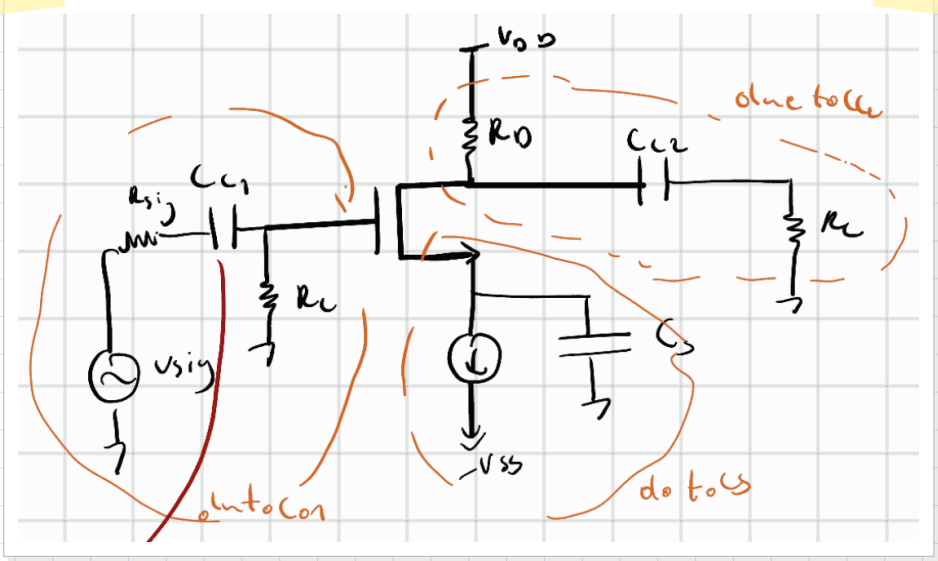
$$\text{CMRR} = \frac{100}{\frac{1}{200}} = 20\,000$$

$$20 \log \left(20 \cdot 10^3\right) = 86\ \text{dB}$$

Frequency response

orj. s. 2

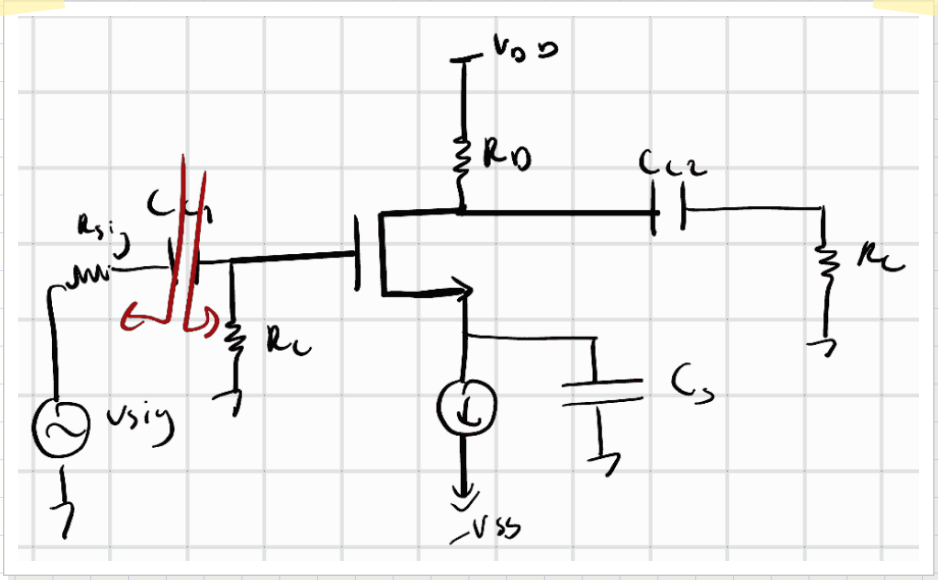
> **Şekil:** Yapıştırılmış basılı ders kitabı şekli: kazancın frekansla değişimi, $|V_o/V_{sig}|$ (dB) eksenine karşı f (Hz, log ölçek). Alçak frekans bandı ("Gain falls off due to the effects of coupling and bypass capacitors"), orta bant ("All capacitances can be neglected", $20 \log |A_M|$ (dB), 3 dB düşüş) ve yüksek frekans bandı ("Gain falls off due to the internal capacitive effects of the BJT or the MOSFET"); alt ve üst kesim frekansları f_L ve f_H.
> *(orijinal notta, s. 2)*



orijinal çizim, s. 2

$$\frac{1}{j\omega C}$$

(ifadenin altında kırmızı, kıvrımlı bir ok var)



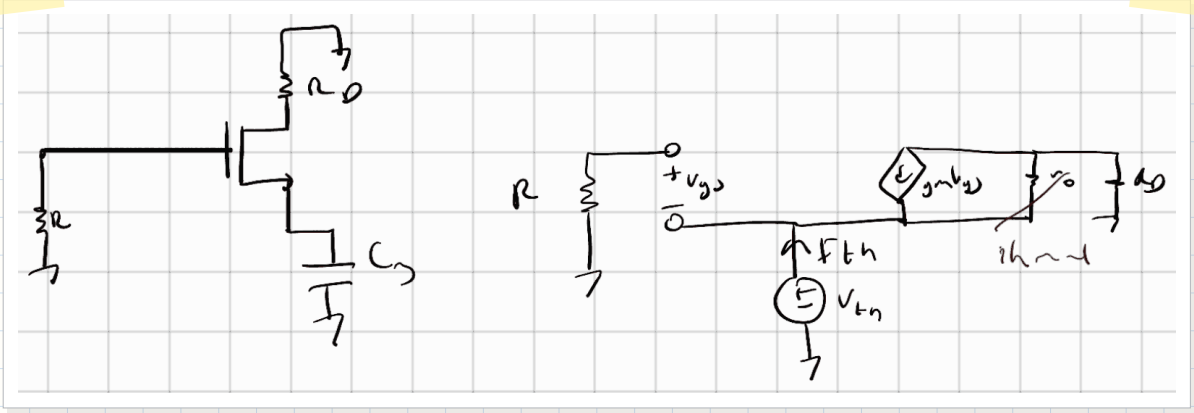
orijinal çizim, s. 2

$$R_{eq} = R_{sig} + R_G$$

$$\omega_{p1} = \frac{1}{C_{C1}(R_{sig} + R_G)}$$

orj. s. 3

2. kapasiteden kaynaklı etkiyi ? koyalım

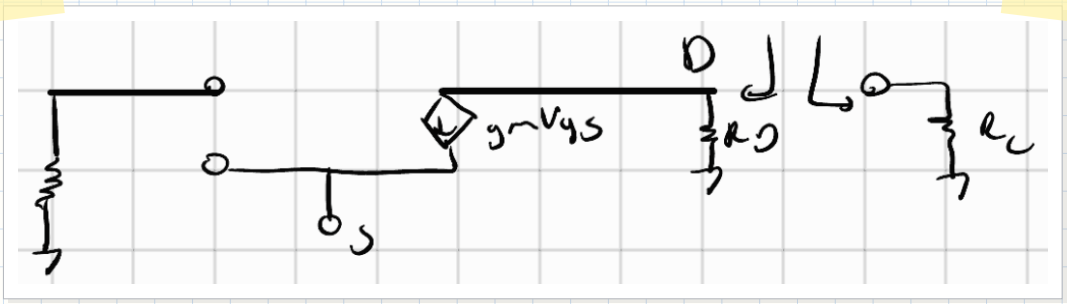


orijinal çizim, s. 3

$$\frac{V_{tn}}{I_{tn}} = ? = \frac{-v_{gs}}{-g_m v_{gs}} = \frac{1}{g_m}$$

(pay ve paydadaki v_{gs} terimleri çizilerek sadeleştirilmiş)

$$\omega_{p2} = \frac{1}{\frac{C_S}{g_m}} = \frac{g_m}{C_S}$$



orijinal çizim, s. 3

$$\omega_{p3} = \frac{1}{(R_D + R_L) C_{C2}}$$

> *Şekil:* Yapıştırılmış basılı şekil: alçak frekans bölgesinde kazanç grafiği, $|V_o/V_{sig}|$ (dB) — f (Hz, log ölçek). Eğim f_{p1}'e kadar 60 dB/decade, f_{p1}–f_{p3} arası 40 dB/decade, f_{p3}–f_{p2} arası 20 dB/decade; f_{p2}'den sonra düz (orta bant, $20 \log |A_M|$, −3 dB işareti, "≈ f_L"). Kesikli düşey çizgiler f_{p1}, f_{p3}, f_{p2}'de.
> *(orijinal notta, s. 3)*

↓ 2 pole, çünkü direnci yüksek

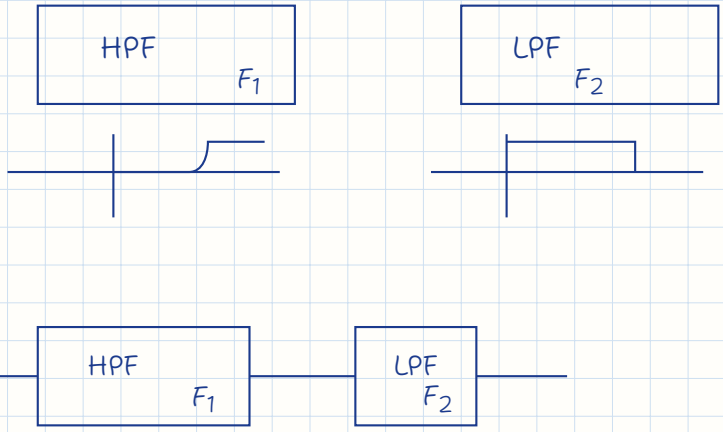
↪ dominant pole diğerlerinin ?Ekatıkalan

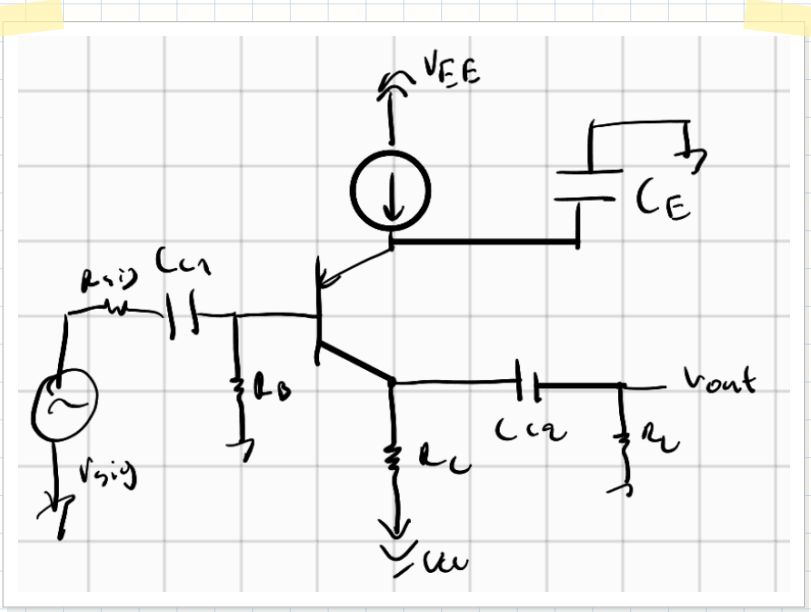
orj. s. 4

$$A_{mid} = -\left[\frac{R_G}{R_{sig} + R_G}\right] g_m (R_D \parallel R_L)$$

$$A(s) = A_{mid}\left[\frac{s}{s + \omega_{P1}}\right]\left[\frac{s}{s + \omega_{P2}}\right]\left[\frac{s}{s + \omega_{P3}}\right]$$

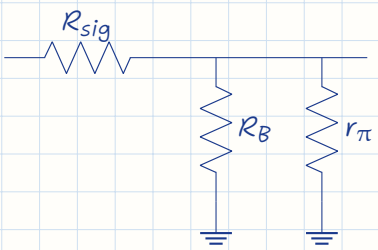
$$f_L = \frac{1}{2\pi}\left(\frac{1}{R_1 C_1} + \frac{1}{R_2 C_2} + \frac{1}{R_3 C_3}\right)$$





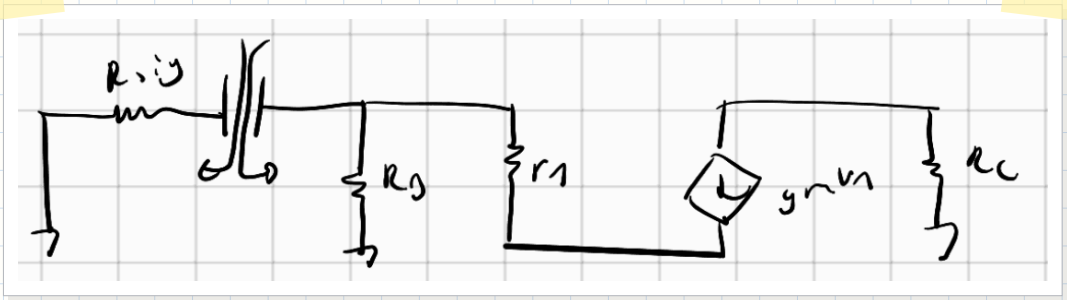
orijinal çizim, s. 4

$$A_m = -g_m (R_C \parallel R_L)\frac{(R_B \parallel r_\pi)}{R_{sig} + (R_B \parallel r_\pi)}$$

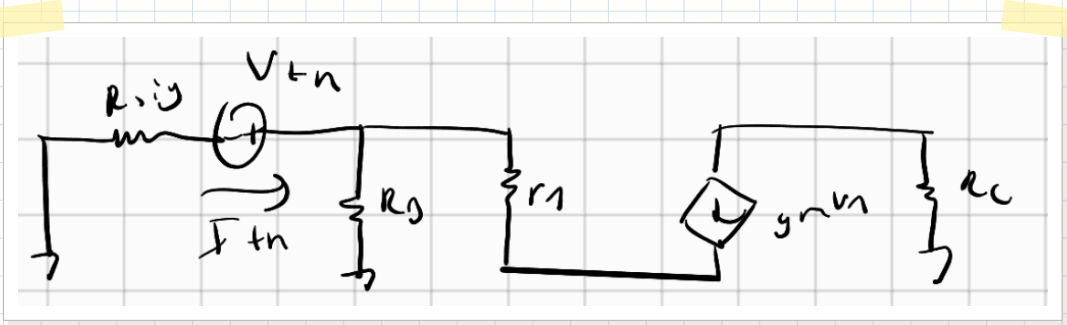


$$A_M = -g_m (R_C \parallel R_L) \frac{(R_B \parallel r_\pi)}{R_{sig} + (R_B \parallel r_\pi)}$$

orj. s. 5



orijinal çizim, s. 5



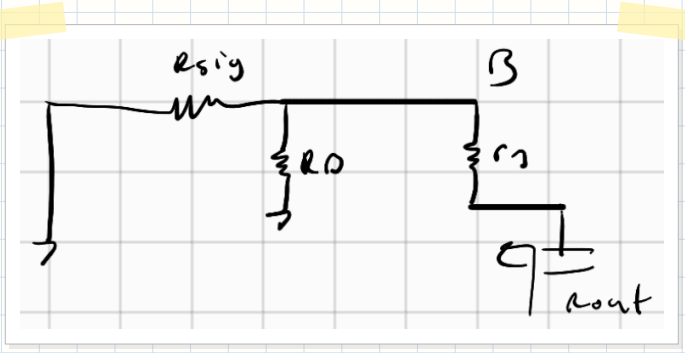
orijinal çizim, s. 5

$$R_1 = R_{CC1} = (R_{sig} + (R_B \parallel r_\pi))$$

$$\omega_{P1} = \frac{1}{C_{C1} (R_{sig} + (R_B \parallel r_\pi))}$$

C_E den bakarken

Low frekansta C'ler short kabul edilir



orijinal çizim, s. 5

$$R_{CE} = R_2 = \frac{(R_{sig} \parallel R_B) + r_\pi}{\beta + 1}$$

$$\omega_{p2} = \frac{1}{\frac{(R_{sig} \parallel R_B) + r_\pi}{\beta + 1} C_E}$$

$$\omega_{p3} = \frac{1}{C_{C2}(R_C + R_L)}$$