DIGITALNA TEHNIKA I

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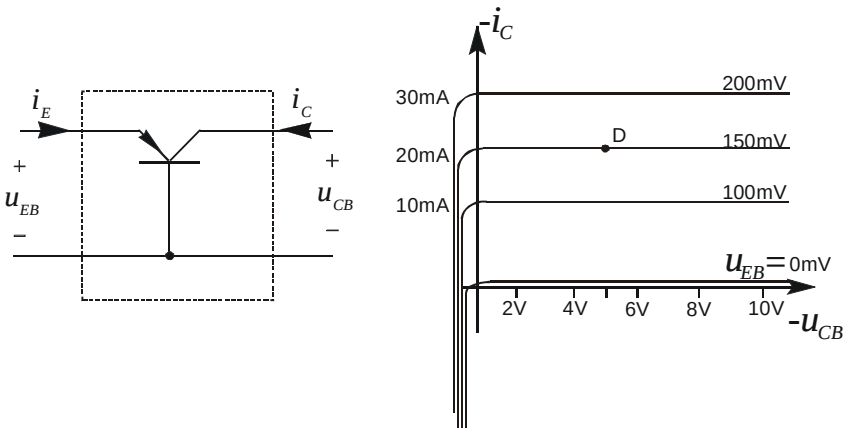
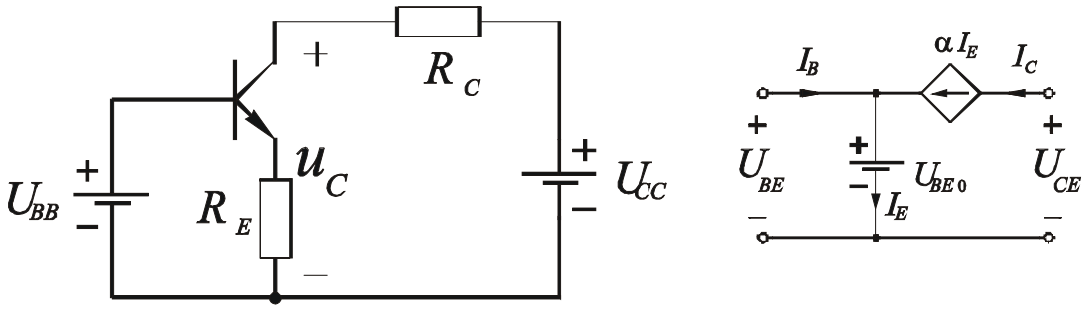
1. Določite prevodnostna četveropolna parametra g_{21} in g_{22} v izbrani delovni točki D za četveropol z grafično podano karakteristiko.
   Izračunajte še napetostno ojačenje A_U tega četveropola v izbrani delovni točki D za majhne počasne signale, če znaša bremenska upornost $R_B=1k\Omega$.



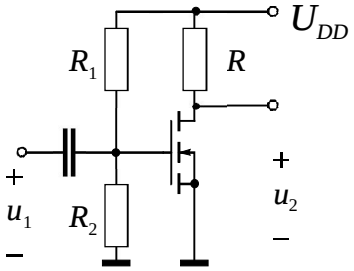
2. Z uporabo operacijskih ojačevalnikov realizirajte spodnjo prenosno funkcijo vezja:

$$u_z = 3u_x - 5u_y$$

3. Kolikšna mora biti upornost R_E, da bo napetost u_C=6V? Upoštevajte podani model tranzistorja! (U_{BE0}=0,7V, α=0,9)
   Ostali podatki: R_C=4kΩ U_{CC}=10V U_{BB}=2V



4. Določite bremenski upor R v podanem ojačevalniku z MOS tranzistorjem z induciranim kanalom, da bo napetost U_{DS} polovica napajalne napetosti U_{DD}.
   U_T = 2 V, K = 1mA/V^2, R_1 = 100 kΩ, R_2 = 43 kΩ, U_{DD} = 10 V



Čas pisanja je 60min. Vsaka naloga je vredna 10 točk. Na list z rešitvami se podpišite in napišite še vpisno številko ter kateri predmet pišete. Rezultati bodo objavljeni v sistemu e-študent.

①

$$I_E = g_{11} U_{EB} + g_{12} U_{CB}$$
$$I_C = g_{21} U_{EB} + g_{22} U_{CB}$$

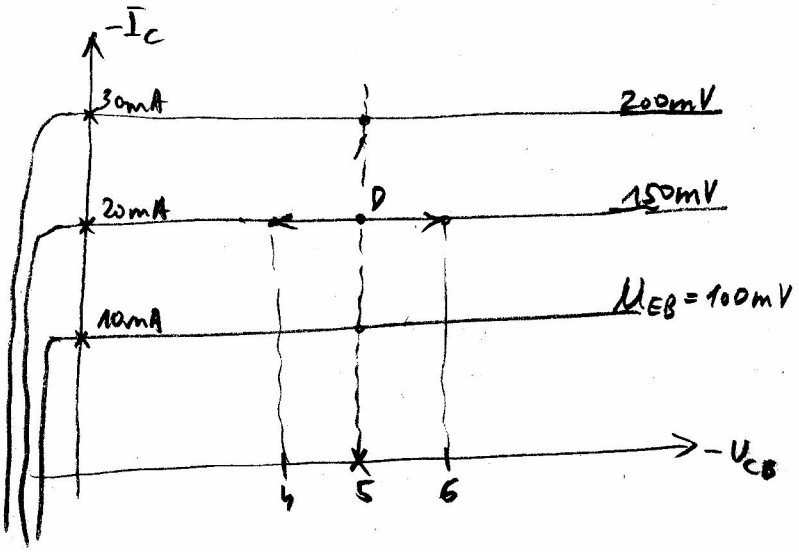
$$g_{21} = \left.\frac{\Delta I_C}{\Delta U_{EB}}\right|_{U_{CB}=\text{konst}}$$

$$g_{22} = \left.\frac{\Delta I_C}{\Delta U_{CB}}\right|_{U_{EB}=\text{konst}}$$

$$g_{21} = \frac{(-30)-(-10)\,mA}{200-100\,mV} = \frac{-20\,mA}{100\,mV}$$

$$g_{21} = -0.2S = -200mS$$

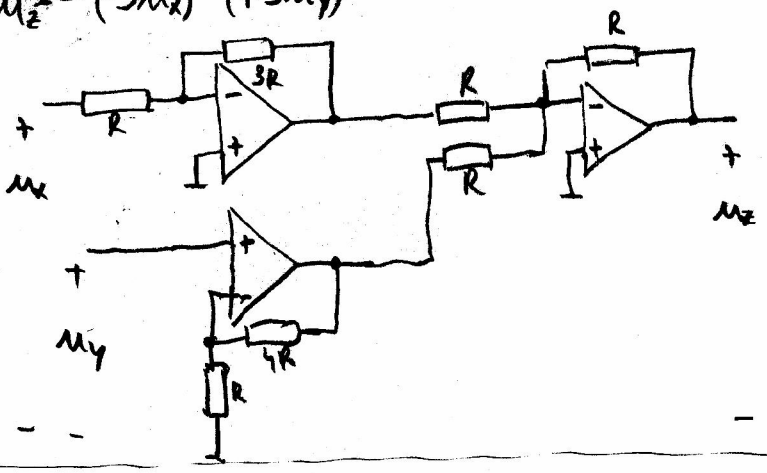
$$g_{22} = \frac{-20mA-(-20mA)}{6V-4V} = 0\,mS$$



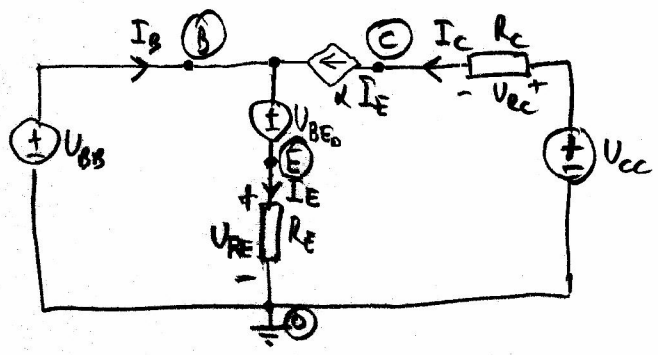
$$A_u = \frac{-g_{21}}{\underset{0}{g_{22}} + \underset{\frac{1}{R_B}=1mS}{G_B}} = \frac{+200mS}{1mS} = \underline{\underline{200}}$$

②

$$u_z = -(-3u_x) - (+5u_y)$$



③



$$U_{RE} = U_{BB} - U_{BE0} = 2V - 0.7V = 1.3V$$

$$U_{CC} = U_{RC} + U_C \rightarrow U_{RC} = U_{CC} - U_{RC} = 4V$$

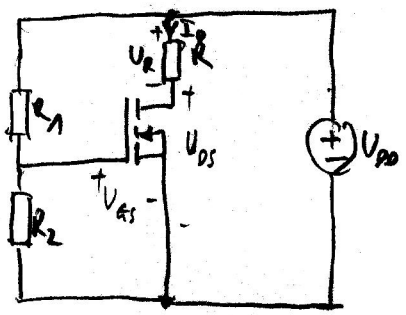
$$U_{RC} = I_C R_C \rightarrow I_C = \frac{U_{RC}}{R_C} = \frac{4V}{4k\Omega} = 1mA$$

$$I_C = \alpha I_E \rightarrow I_E = \frac{I_C}{\alpha} = 1.11mA$$

$$R_E = \frac{U_{RE}}{I_E} = \frac{1.3V}{1.11mA} = 1.17k\Omega$$

④

$U_{DS} = \frac{U_{DD}}{2}$



$U_{GS} = U_{DD} \cdot \frac{R_2}{R_1 + R_2} \doteq 3V$

$U_{DS} = \frac{U_{DD}}{2} = 5V \rightarrow U_{DS} > U_{GS} - U_T$

$5V > 3V - 2V$ ✓ NASICENJE

$I_D = \frac{k_N}{2} \cdot (U_{GS} - U_T)^2 = \frac{1mA/V^2}{2} \cdot 1V^2 = \underline{0.5mA}$

$U_{DD} = U_R + U_{DS} \rightarrow U_R = 5V$

$R = \frac{U_R}{I_D} = \underline{10k\Omega}$