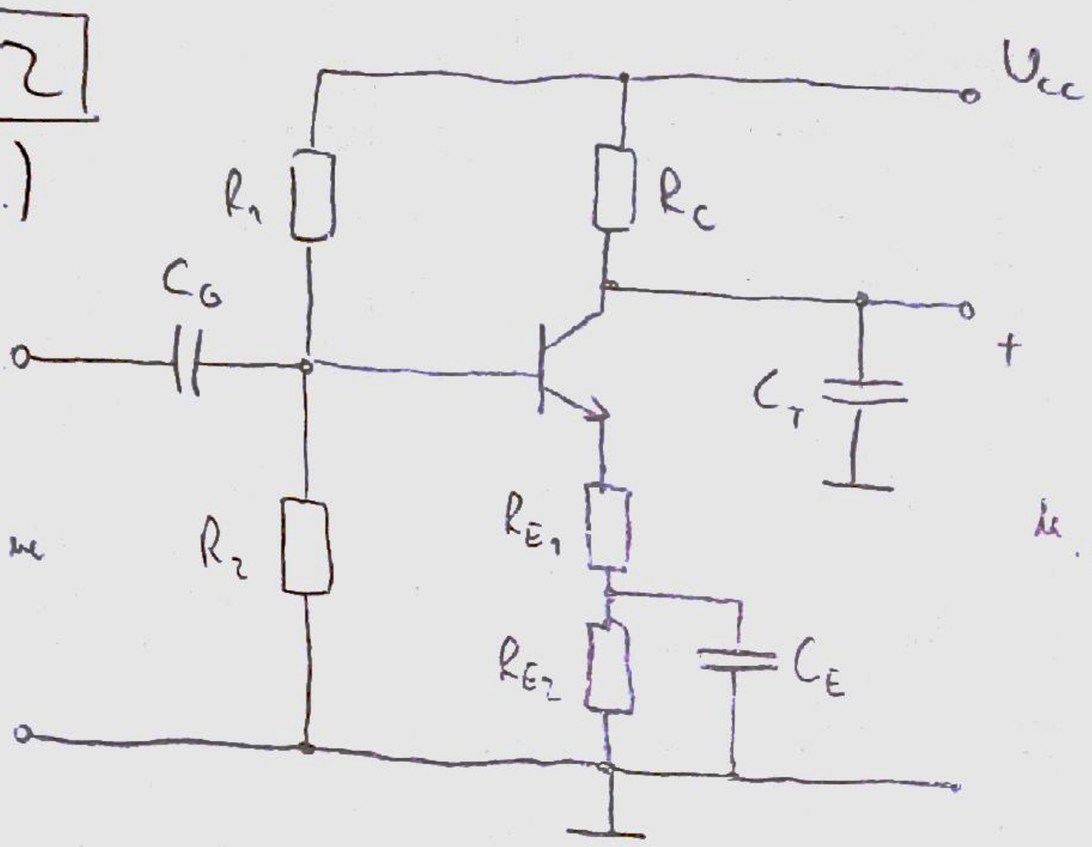
ELEKTRONIKA 2

3. LAB. VJEŽBA

3.2

2.)



$U_{CC} = 12\,V$ $\quad C_G = 1\,\mu F$

$R_1 = 8{,}2\,k\Omega$ $\quad C_E = 33\,\mu F$

$R_2 = 3{,}3\,k\Omega$ $\quad C_T = 100\,pF$

$R_C = 1{,}8\,k\Omega$ $\quad \beta = h_{FE} = 150$

$R_{E1} = 150\,\Omega$

$R_{E2} = 820\,\Omega$

STATIKA

$$U_{BB} = \frac{R_2}{R_1 + R_2} U_{cc} = 3{,}443\,V \qquad R_B = R_1 \| R_2 = 2353\,\Omega$$

$$U_{BB} - I_{BQ} R_B - U_{BEQ} - (1+\beta) I_{BQ} (R_{E1} + R_{E2}) = 0$$

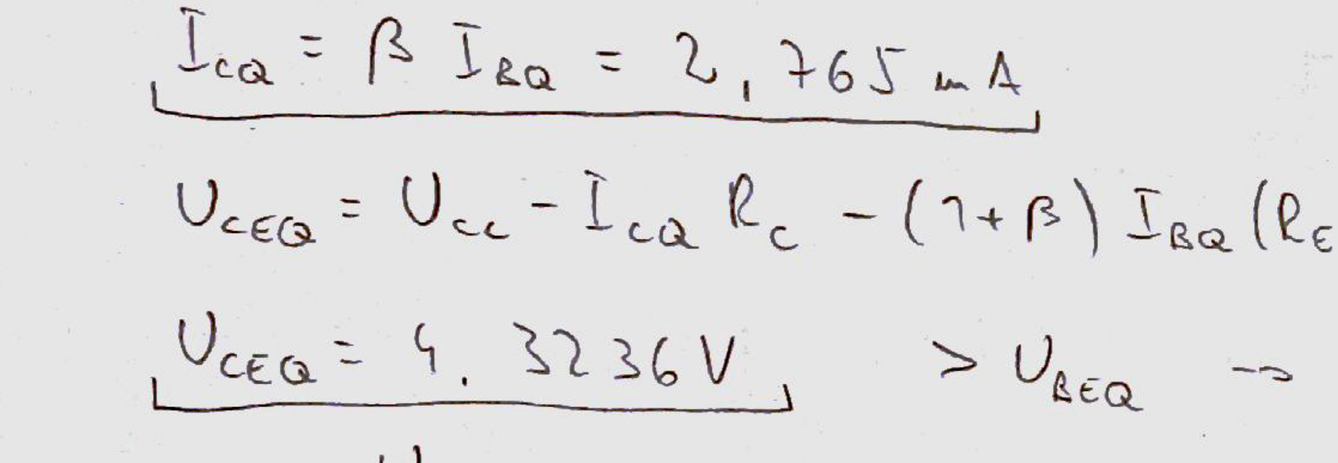
$$I_{BQ} = \frac{U_{BB} - U_{BEQ}}{R_B + (1+\beta)(R_{E1} + R_{E2})} = \underline{18.43\,\mu A}$$

$$\underline{I_{CQ} = \beta I_{BQ} = 2{,}765\,mA}$$

$$U_{CEQ} = U_{cc} - I_{CQ} R_C - (1+\beta) I_{BQ} (R_{E1} + R_{E2})$$

$$\underline{U_{CEQ} = 4.3236\,V} \quad > U_{BEQ} \rightarrow \underline{NAP}$$

$$\underline{r_{B'E} = \frac{U_T}{I_{BQ}} = 1356\,\Omega} \qquad \underline{r_{BB'} = 0\,\Omega}$$



djeluje na V_F

$$U_{izQ} = U_{CC} - I_{CQ} R_C = 7{,}023\,V$$

$$u_{ce} = -i_c (R_C + R_{E1}) \qquad (i_e \approx i_c)$$

$$i_c = -\frac{1}{R_C + R_{E1}} u_{ce} \,.$$

* úhupní hod

$$(i_c - I_{cQ}) = -\frac{1}{R_c + R_{E_1}}(u_{ce} - U_{ceQ})$$ - dinamický, radní pravoc

$$u_{iz} = -i_c R_c$$

$$i_c = -\frac{1}{R_c + R_{E_1}}(u_{CE} - U_{ceQ}) + I_{cQ}$$

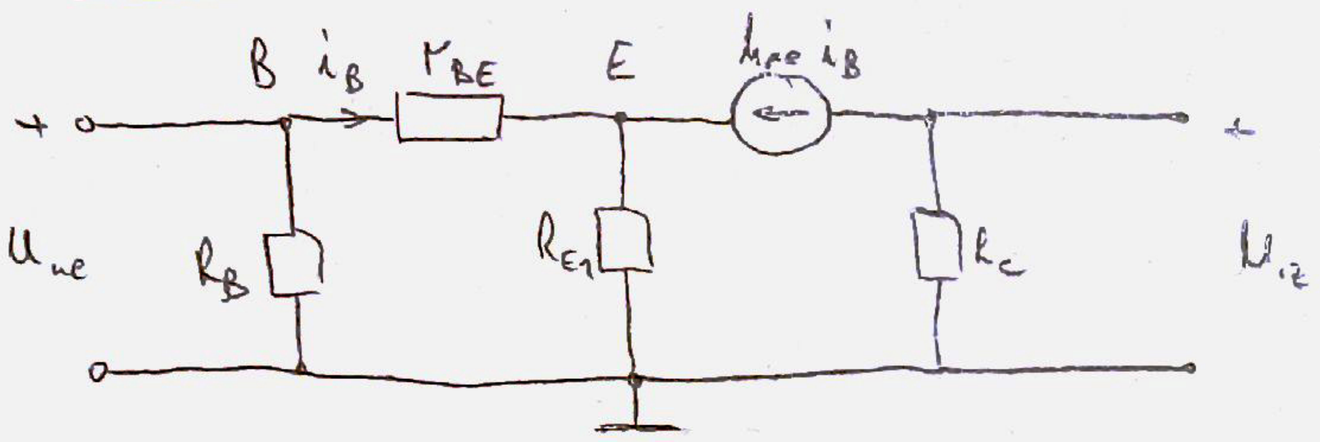
$$\Delta i_{cg} = i_c(u_{CE}=0) - I_{cQ} = \underline{2.217\ mA}$$

$$\Delta i_{cd} = I_{cQ} = 2.765\ mA$$

$$|\Delta u_{iz\,MAX}| = \Delta i_{C\,MAX} R_c$$

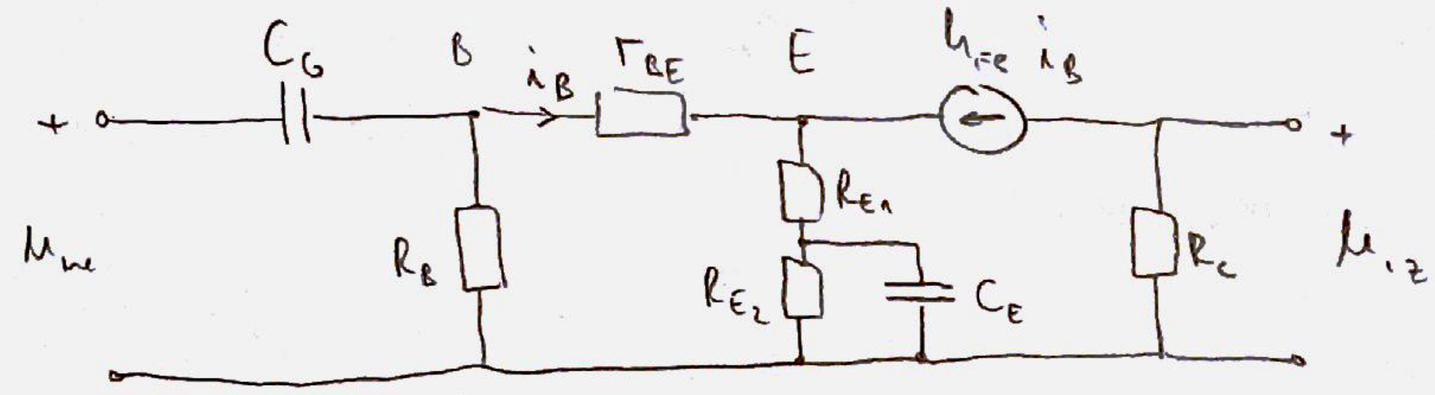
$\Delta i_{C\,MAX}$

$$\underline{|\Delta u_{iz\,MAX}| = 3.9906\ V}$$



$$\underline{A_{vo}} = \frac{u_{.z}}{u_{ve}} = \frac{u_{.z}}{i_B}\,\frac{i_B}{u_{ve}} = -h_{FE} R_C \cdot \frac{1}{r_{BE} + (1+h_{FE})R_{E_1}} = \underline{-11.247}$$

3.)



* $\tau_{G_1} = C_G \cdot (R_B \,||\, (r_{BE} + (1+h_{FE})R_{E_1}))$ .... $\omega_G > \omega_E$ ... $\tau_G < \tau_E$

($r_{BE} + (1+h_{FE})R_{E_1} \approx 2400\,\Omega$)

$\tau_{G_1} = 2.143 \cdot 10^{-3}\ s$ $\omega_{G_1} = 466.6\ rad/s$ ✗

$\tau_{E_1} = C_E \left(R_{E_2} \,||\, \left(R_{E_1} + \frac{r_{BE} + R_B}{1+h_{FE}} \right) \right)$ ---- $\omega_G > \omega_E$

($\frac{r_{BE} + R_B}{1+h_{FE}} \approx 174.56\,\Omega$)

$\tau_{E_1} = 5.76 \cdot 10^{-6}\ s$ $\omega_{E_1} = 173.594 \cdot 10^3\ rad/s$ ✗ ~~$\omega_G > \omega_E$~~

$\omega_E > \omega_G$ $\tau_{G_2} = C_G \cdot (R_B \,||\, (r_{BE} + (1+h_{FE})(R_{E_1} + R_{E_2}))) = 2.316 \cdot 10^{-3}\ s$ $\underline{\omega_{G_2} = 431.75\ rad/s}$

($r_{BE} + (1+h_{FE})(R_{E_1} + R_{E_2}) \approx 147826\,\Omega$)

$\tau_{E_2} = C_E \left(R_{E_2} \,||\, \left(R_{E_1} + \frac{r_{BE}}{1+h_{FE}} \right) \right) = 4.394 \cdot 10^{-6}\ s$ $\underline{\omega_{E_2} = 227.56 \cdot 10^3\ rad/s}$

($R_{E_1} + \frac{r_{BE}}{1+h_{FE}} \approx 159\,\Omega$)

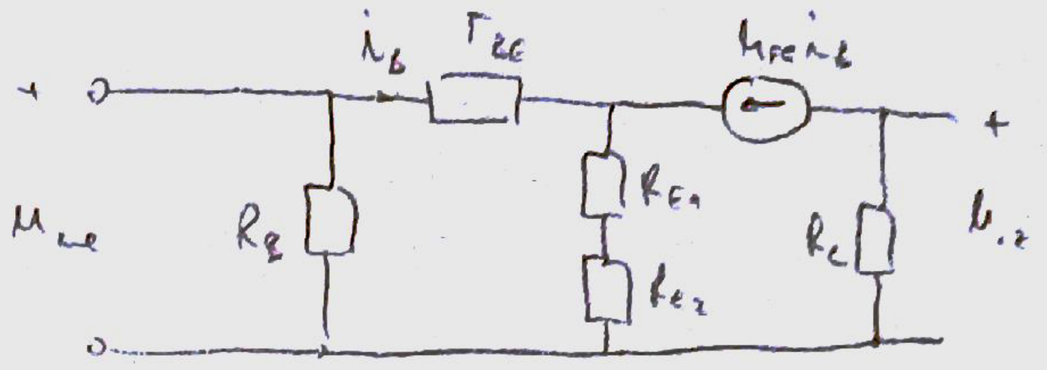
$\tau_1 = R_{E_2} C_E = 2.706 \cdot 10^{-5}\ s$ $\underline{\omega_1 = 36.95 \cdot 10^3\ rad/s}$

ELEKTRONIKA 2

3. LAB. VJEŽBA

3.2

3.) * na stavak



$$\omega_{E_2} >> \omega_{G_2}, \omega_1$$

$$\omega_d = \omega_{E_2} = \underline{227\,560 \text{ rad/s}}$$

$$f_d = \frac{\omega_d}{2\pi} = \underline{36.218 \text{ kHz}}$$

$$A_{VM} = \left.\frac{u_{iz}}{u_{ul}}\right| = \frac{u_{iz}}{i_B}\,\frac{i_B}{u_{ul}} = -h_{FE} R_C \frac{1}{r_{BE} + (1+h_{FE})(R_{E1}+R_{E2})}$$

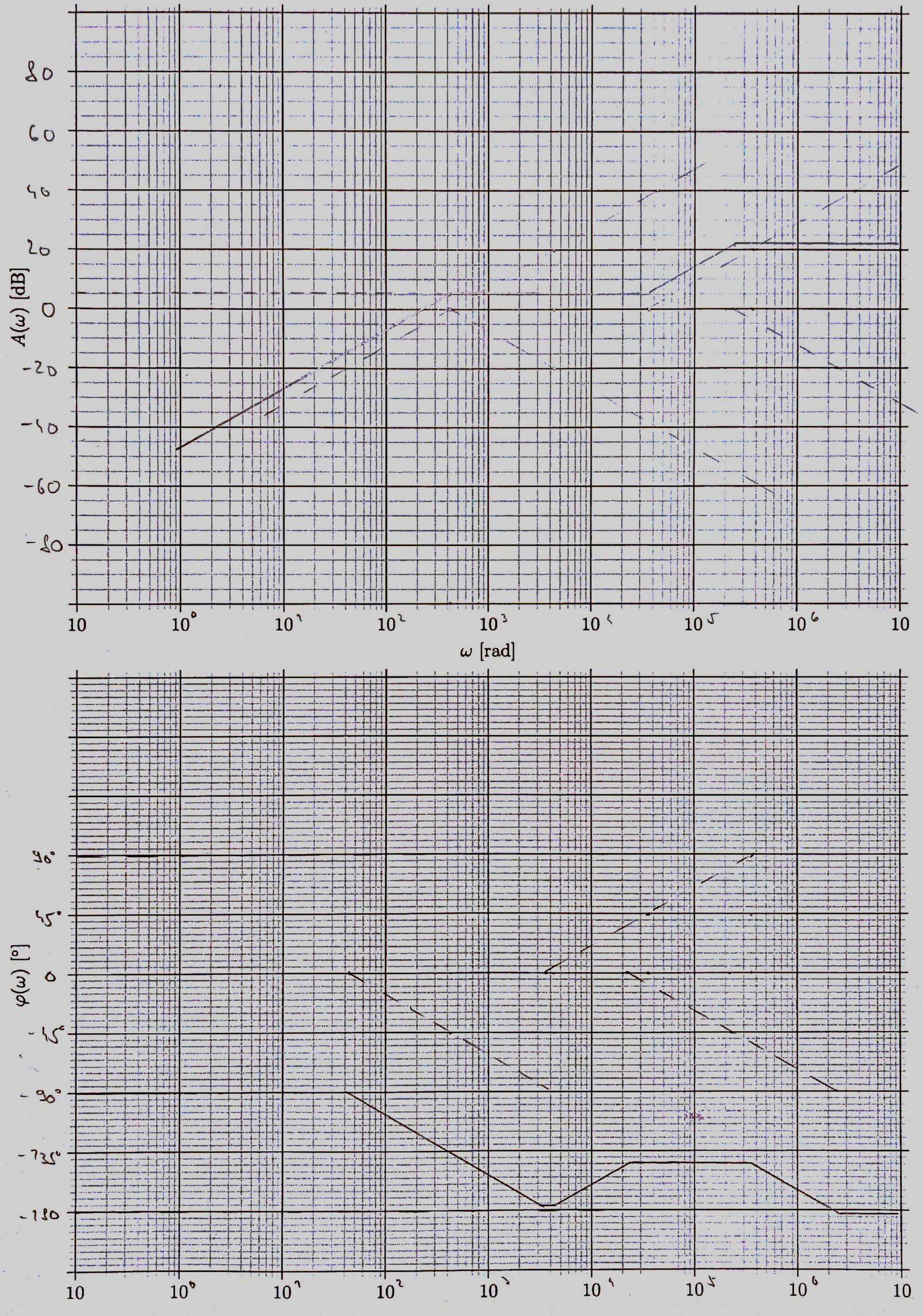
$\omega_G < \omega < \omega_E$

$$\underline{A_{VM} = -1.826}$$

$$A(j\omega) = A_{VM} \frac{j\frac{\omega}{\omega_{G_2}}}{1+j\frac{\omega}{\omega_{G_2}}} \cdot \frac{1+j\frac{\omega}{\omega_1}}{1+j\frac{\omega}{\omega_{E_2}}}$$

$$A(j\omega) = -1.826 \frac{j\omega \cdot 2.316\cdot 10^{-3}}{1+j\omega\cdot 2.316\cdot 10^{-3}} \cdot \frac{1+j\omega\, 2.706\cdot 10^{-5}}{1+j\omega\, 4.394\cdot 10^{-6}}$$

$$A(j\omega) = -1.826 \frac{j\frac{\omega}{431.75}}{1+j\frac{\omega}{431.75}} \cdot \frac{1+j\frac{\omega}{36.95\cdot 10^3}}{1+j\frac{\omega}{227.56\cdot 10^3}}$$


80
60
40
20
0
-20
-40
-60
-80
A(ω) [dB]
10
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10
ω [rad]
90°
45°
0
-45°
-90°
-135°
-180
φ(ω) [°]
10
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10