1)

$$R_1 = \frac{V_{CC} - V_{BEon}}{I_{ref}} = \frac{15V - 0.7V}{1mA} = 14.3kOhm$$

$$R_2 = \frac{V_T}{I_{C2}} \cdot \ln\frac{I_{ref}}{I_{C2}} = \frac{26mV}{5\mu A} \cdot \ln\frac{1mA}{5\mu A} = 27.55kOhm$$

Çıkış direnci:

$$Ro = \frac{V_A}{I_{C2}}\left[1 + \frac{I_{C2}.R_2}{V_T}\right] = \frac{130V}{5\mu A}\left[1 + \frac{5\mu Ax27.55kOhm}{26mV}\right] = 163,7MOhm$$

2)

a)

$$\Delta V_{BE} = V_{BE1} - V_{BE2} = V_T.\ln(m)$$

$$I = \frac{\Delta V_{BE}}{R_1} = \frac{V_T}{R_1}.\ln(m) \qquad I_{C4} = I_{C3}, \qquad I_{C1}=I_{C5}=I$$

$$V_{ref} = V_{BE1} + 2.I.R_2 = V_{BE1} + V_T\frac{2R_2}{R_1}.\ln(m)$$

$$V_O = V_{ref}\frac{R_3 + R_4}{R_4}$$

b)

$$R_1 = \frac{\Delta V_{BE}}{I} = \frac{V_T}{I}.\ln(m) = \frac{26mV}{100\mu A}.\ln(2) = 180Ohm$$

$$\frac{\partial V_{ref}}{\partial T} = 0 \rightarrow \frac{R_2}{R_1} = \frac{-\left(\partial V_{BE}/\partial T\right)}{\left(\partial V_T/\partial T\right).2.\ln(m)} = 21.22 \qquad \rightarrow \qquad R_2 = 3819\ Ohm$$

$$V_{ref} = 1.464V \rightarrow \frac{R_3}{R_4} = 1.05$$

3)

a- $ye = \dfrac{2.I_1}{C_1} = 4.\pi.f_1.V_T = 1.63V/\mu sn$ $\rightarrow$ $2.I_1 = ye.C_1 = 1.63x10^6 \ x \ 5x10^{-12} = 8.15\mu A$

b- $V_{CC} - V_{CEsat} = 2.5V - 0.2V = 2.3V$ $\rightarrow$ maksimum genlik $E_O = 2.3V$ olur.

$\rightarrow$ $I_2.R_{Lmin} = E_O \rightarrow R_{L\min} = \dfrac{2.3V}{0.5mA} = 4.6kOhm$

c- Tam güç band genişliği

$\omega_P = \dfrac{ye}{E_O} = \dfrac{1.63x10^6}{2.3} = 708695 rad/sn \rightarrow$ $f_P = 112.849kHz$