$$\frac{T_{t3}}{T_{tR}} = \frac{T_{t3}}{T_0}\frac{T_0}{T_{tR}} = \tau_\lambda \frac{1}{\tau_{\lambda R}}$$

$\Rightarrow$

$$\frac{\tau_m \tau_\lambda}{\tau_{\lambda R}} = \frac{1 + \beta^{-1}\frac{\tau_\lambda}{\tau_{\lambda R}}}{1+\beta^{-1}}$$

$$\tau_m = \frac{\tau_{\lambda R}}{\tau_\lambda}\left(\frac{\beta + \tau_\lambda/\tau_{\lambda R}}{\beta+1}\right)$$

$$\boxed{\tau_m = \frac{1}{1+\beta}\left[1 + \beta\frac{\tau_{\lambda R}}{\tau_\lambda}\right]}$$

c)

$$\pi_m = \frac{P_{t4}}{P_{t3}} = \frac{P_{t4}}{P_{tR}}\frac{P_{tR}}{P_{t3}}$$

$\frac{P_{t4}}{P_{tR}}$: mixer output

$\frac{P_{tR}}{P_{t3}}$: mixer input, along with $\frac{T_{t3}}{T_{tR}}, M_{Re}, \beta$

$\therefore$ need mixer inputs

$$\frac{P_{t3}}{P_{tR}} = \frac{\pi_b' \pi_r P_0}{P_{tR}} \qquad \frac{T_{t3}}{T_{tR}} = \frac{\tau_\lambda T_0}{T_{tR}}$$