یالطیف

رضا ادیب پور

۹۸۱۴۳۰۳

تمرین سری ۴ مدارمخابراتی

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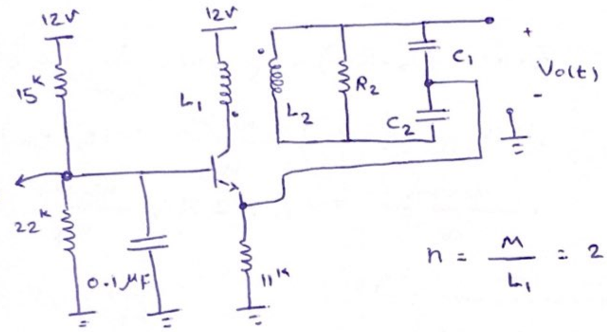
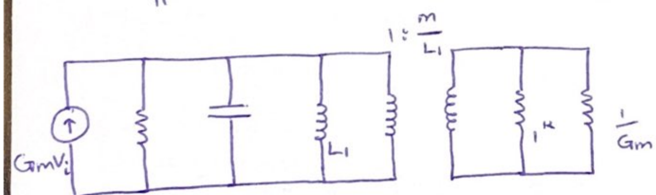


$$n = \frac{M}{L_1} = 2.5$$

$$V_{BB} = \frac{22^K}{22^K + 37^K} \times 12 = 7.13 \Rightarrow V_C = 7.13 - 0.7 = 6.43$$

$$I_{CQ} = \frac{6.5}{11^K} = 0.6^{mA} \Rightarrow g_m = \frac{0.6}{V_T} = 15 \frac{mA}{V}$$



$$C = \frac{0.04^{\mu} \times 200^{P}}{0.04 + 200} = 2 \times 10^{-10}$$

$$W_0 = \frac{1}{\sqrt{LC}} = 15 \frac{MRad}{S}$$

$$|A(j\omega)| = 1 \Rightarrow \frac{G_m}{g_m} = \frac{G_L + n^2 G_E}{n(1-n) g_m} \Rightarrow \frac{G_m(V)}{g_m} = 0.67$$

$$x = 3.2 \Rightarrow V_o(t) = 12 - 8.5 \cdot \cos(15 \times 10^6 t)$$

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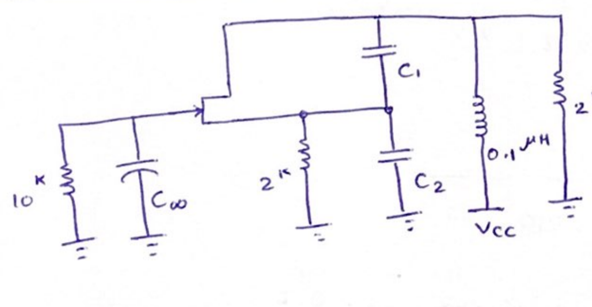
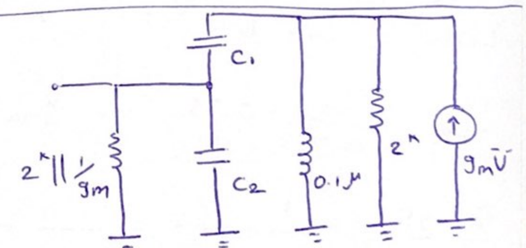


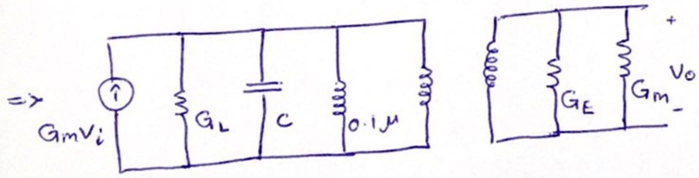
$\Rightarrow$



$$W_0 = 2\pi f = 2 \times 3.14 \times 40^{MHZ} = 250 \frac{MRad}{S}$$

$$\frac{1}{\sqrt{LC}} = 250 \times 10^6 = \frac{1}{\sqrt{0.1C}} \Rightarrow C = 0.16^{nF}$$

$\Rightarrow$



$$\frac{250 \times 10^6 (C_1 + C_2)}{0.5} = 100 \Rightarrow C_1 + C_2 = 0.2^{\mu F}$$

$$n = \frac{C_1}{C_1 + C_2} = \frac{M}{L_1} = 8 \Rightarrow \frac{C_1}{C_1 + C_2} = 8 \Rightarrow C_1 = 0.16\ \mu F \quad , \quad C_2 = 0.04\ \mu F$$

$$g_m = \frac{G_L}{n} = \frac{100}{8} = 12.5\ \text{mmho}$$

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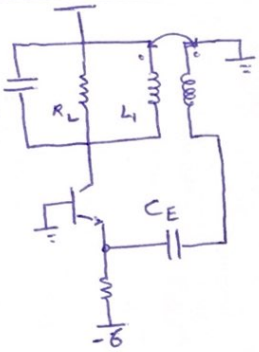

$$\omega_o = 2\pi(10 - 0.02) = 2\pi(9.98)$$

$$Q_t = 72$$

$$Z(j\omega) = (r_s + R_{in}) + j\left(L_s\omega - \frac{1}{C_s\omega}\right) = (r_s + R_{in}) + j2Q_{eff}(r_s + R_{in})\frac{\omega - \omega_s}{\omega_s} = (r_s + R_{in}) + j2Qr_s \times \frac{\omega - \omega_s}{\omega_s} \Rightarrow X = 2Qr_s\frac{\omega - \omega_s}{\omega_s}$$

$$\Rightarrow |T(j\omega_o)| = \frac{(\alpha n R_L)^2}{1 + Q_t^2\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right)^2} \times \frac{1}{(r_s + R_{in}) + X^2} = 1$$

$$\Rightarrow \tan^{-1}\left(Q_t\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right)\right) = \tan^{-1}\left(\frac{X}{R_{in} + r_s}\right) \Rightarrow Q_t\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right) = \frac{X}{r_s + R_{in}}$$

$$\Rightarrow r_s + R_{in} = \frac{\alpha n R_L}{1 + Q_t^2\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right)^2} \quad , \quad \omega \simeq \omega_s = 2\pi(10)^{MHz}$$

$$R_{in} = \frac{\alpha n R_L}{1 + Q_t^2\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right)^2} - r_s = 39.9^{\Omega}$$

$$X = -(r_s + R_{in})Q_t\left(\frac{\omega}{\omega_o} - \frac{\omega_o}{\omega}\right) = -69.9 \times 72\left(\frac{10}{9.98} - \frac{9.98}{10}\right) = -20.13^{\Omega}$$

$$n = \frac{C_1}{C_1 + C_2} = 0.0196 \Rightarrow C = \frac{C_1 C_2}{C_1 + C_2} = 294^{PF}$$

$$LC\omega_s^2 = 1 \Rightarrow L = 0.86^{\mu H} \quad , \quad Q_t = R_L C \omega_s = 72$$

$$I_{EQ} = \frac{9.3}{12.7^{k}} = 0.73^{mA} \quad , \quad g_{mQ} = \alpha\frac{I_{CQ}}{V_T} = 27.88^{\text{mmho}}$$

$$\frac{G_m(y)}{g_{mQ}} = \frac{1}{(\alpha n R_L - r_s)g_{mQ}} = \frac{1}{(0.99 \times 0.196 \times 3.9 - 30) \cdot 27.88} = 0.765$$

$$\Rightarrow V_o(t) = \cancel{}\ V_{cc} + \alpha I_E \cos\omega_o t = 10 + 2.35\cos(2\pi \times 10^8 t)$$

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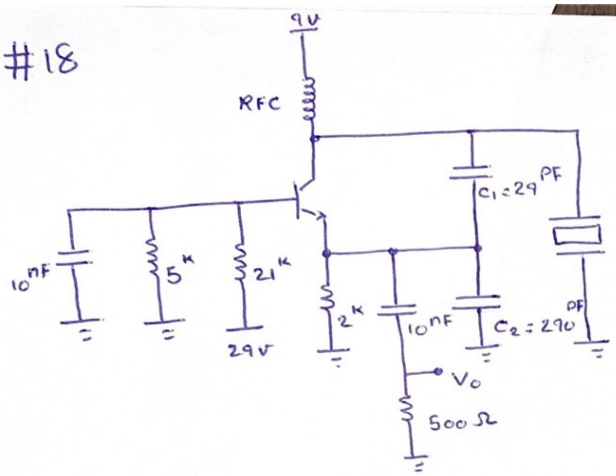

$$Q_x = \frac{L_s W_s}{r_s} = 45000 \Rightarrow L_s = 71.65^{mH}$$

$$L_s C_s W_s^2 = 1 \Rightarrow C_s = 0.0035^{PF}$$

$$f_p = f_s \left(1 + \frac{C_s}{C_p}\right) = 10.0174^{MHZ}$$

$$C = \frac{C_1 C_2}{C_1 + C_2} = 27^{PF}, \quad C_1 = C + C_p = 28^{PF}$$

$$n = \frac{C_1}{C_1 + C_2} = 0.1$$

$$W_p C_1 = 1.761^{MHZ}$$

$$Z_x = r_s + jQ_x\left(\frac{W}{W_s} - \frac{W_s}{W}\right) = r_s + j\frac{Q_x}{r_s} \cdot \frac{(W - W_s)(W + W_s)}{W W_s} \cong r_s\left(1 + 2jQ\frac{W - W_s}{W_s}\right)$$

$$Y_x = \frac{1}{Z_x} = \frac{1}{r_s\left(1 + 4Q_x^2\left(\frac{\Delta W}{W_s}\right)\right)^2} - j\frac{2Q}{r_s} \cdot \frac{\Delta W}{W_s\left(1 + 4Q_x^2\left(\frac{\Delta W}{W_s}\right)^2\right)}$$

$\Delta W = W - W_s$ سیگنال انحراف از فرکانس تشدید سری

$C_1 W_s + B_x = 0$ شرط نوسان ساز

$$\Rightarrow \frac{-2Q_x \cdot \Delta W}{r_s W_s\left(1 + 4Q_x^2\left(\frac{\Delta W}{W_s}\right)^2\right)} + 1.761 = 0$$

$$\Rightarrow 2Q_x \frac{\Delta W}{W_s} = \begin{cases} 5.496 \Rightarrow Y_x = (0.302 - j1.76) \\ 0.186 \Rightarrow Y_x = (9.679 - j1.76) \end{cases}$$

$$G_x = 0.302$$

$$G_m = \frac{G_x + G_L}{n\left(1 - \frac{n}{\alpha}\right)} = 8.98\,(G_x + 0.2)$$

$$\Rightarrow G_x = 9.679^{mmho}$$

$$\frac{G_m}{g_{mQ}} = 0.158 \Rightarrow x = 12.1 \Rightarrow 2Q_x = \frac{\Delta W}{W_s} = 5.496, \quad \Delta W = \frac{5.496}{2Q_x} = 3.835$$

$$W = W_s + \Delta W \Rightarrow f = 10.00061^{MHZ}$$

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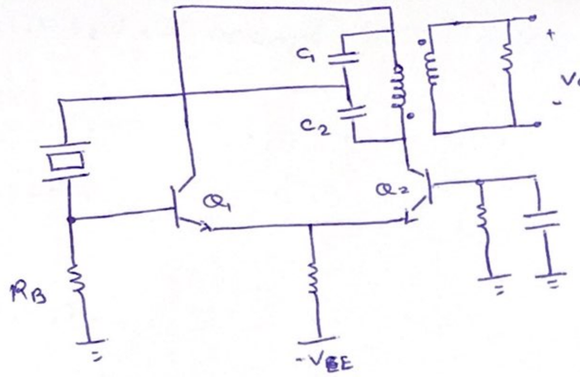

$$\omega_o = \frac{1}{\sqrt{LC}} \quad , \quad n = \frac{M}{L_1} \quad , \quad G_{in} = \frac{G_{md}}{\beta} \quad , \quad Q_t = \frac{\omega_o C}{G_L + n^2 G/\beta} = R_L C \omega_o$$

$$\frac{G_m}{g_{mQ}} = \frac{Q_L}{g_{md}\, n\,(1 - n/\beta)} = \frac{4\alpha_1(x)}{x} \quad , \quad g_{md} = \alpha \frac{I_k}{4V_T}$$

$$\omega_o = 10^7 \ \frac{Rad}{s} \quad , \quad n = \frac{M}{L_1} = 0.02 \quad , \quad g_{md} = \frac{I_k}{4V_T} = 99.01$$

$$\frac{G_m}{g_{md}} = \frac{G_L}{g_{md}\, n\,(1 - n/\beta)} = \frac{0.2}{99.01 \times 0.02\,(1 - 0.02/100)} = 0.404$$

$$\frac{4\alpha_1(x)}{x}$$ از نمودار $\Rightarrow x \approx 6$

$$\Rightarrow \begin{cases} V_{o_1}(t) = 0.7 + x V_T \cos 10^7 t = 0.7 + (156^{mv}) \cos 10^7 t \\ \\ V_o(t) = V_{cc} + \dfrac{x V_T}{n} \cos 10^7 t = V_{cc} + (7.8^{v}) \cos 10^7 t \end{cases}$$