第三章: 3.1 . 3.3 . 3.8 . 3.9

3.1 (1) 交流负载 $R_L' = n^2 R_L = 128\Omega$　　甲类功放

由最佳匹配可得: $V_{cm} = E_{cc}$　$I_{cm} = I_{CQ}$

$P_{omax} = \frac{1}{2}\frac{E_{cc}^2}{R_L'} = \frac{1}{2}\times\frac{12^2}{128} = 562.5mW$

$\eta_c = \frac{P_{omax}}{P_{DC}} = \frac{\frac{1}{2}\cdot V_{cm}\cdot I_{cm}}{E_{cc}\cdot I_{CQ}} = 50\%$

P_O: 功率管输出的交流功率

P_C: 放大管的集电极损耗

P_{DC}: 直流电源提供给放大器的总的直流功率（采用时变偏压供电时，指的是电源提供的平均功率）

(2) 由(1)可知 $P_{DC} = E_{cc}\cdot I_{CQ} = 2\times 562.5mW$

解得 $I_{CQ} = \frac{3}{32}A$　(ICQ不变 不用变压器 负载改变)

$P_{omax} = \frac{1}{2}(I_{CQ})^2 R_L = \frac{1}{2}\times(\frac{3}{32})^2\times 8 = 35.16mW$

$\eta_c = \frac{P_{omax}}{P_{DC}} = 3.125\%$

(3) $R_L' = n^2 R_L = 256\Omega$　　负载改变 导致 I_{cm} 发生改变

$I_{cm} = \frac{E_{cc}}{R_L'} = \frac{3}{64}A$

$P_{omax} = \frac{1}{2}I_{cm}V_{cm} = \frac{1}{2}\times\frac{3}{64}\times 12 = 281.25mW$

$\eta = \frac{P_{omax}}{P_{DC}} = 25\%$

3.3 (1) $P_C = \frac{1}{2}I_L^2 R_L = \frac{1}{2}\times(0.45)^2\times 35 = 3.54W$

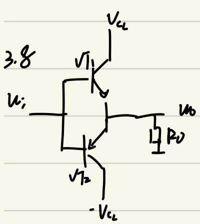
(2) 电源平均电流为 I_L 的均值分量

$\bar{I}_L = \frac{I_L}{\pi}$　　第三章PPT 6页

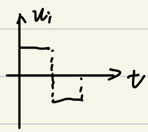
$P_{DC} = \frac{V_{cc}}{2}\cdot\bar{I}_L\times 2 = 5.01W$

$\eta_c = \frac{P_C}{P_{DC}} = 70.7\%$

3.8



假设 u_i 是幅度足够大的方波



① $u_i>0$时　VT1导通　VT2截止

$P_{DC1} = V_{cc}\cdot\frac{V_{cc}-V_{CES}}{R_L}$

$P_{o1} = \frac{(V_{cc}-V_{CES})^2}{R_L}$

② $u_i<0$时　VT1截止　VT2导通

$P_{DC2} = \frac{-V_{cc}\cdot(-V_{cc}+V_{CES})}{R_L} = \frac{V_{cc}(V_{cc}-V_{CES})}{R_L}$

$P_{o2} = \frac{(-V_{cc}+V_{CES})^2}{R_L} = \frac{(V_{cc}-V_{CES})^2}{R_L}$

例 $P_{DC}=\frac{P_{01}\cdot\frac{T}{2}+P_{02}\cdot\frac{T}{2}}{T}=\frac{V_{cc}(V_{cc}-V_{ces})}{R_L}$

$P_o=\frac{P_{01}\cdot\frac{T}{2}+P_{02}\frac{T}{2}}{T}=\frac{(V_{cc}-V_{ces})^2}{R_L}$

$\eta_c=\frac{P_o}{P_{DC}}=\frac{V_{cc}-V_{ces}}{V_{cc}}=1-\frac{V_{ces}}{V_{cc}}$

3.9 $\cos\varphi=\frac{V_1+E_B}{V_b}=0$ $\varphi=90°$ 临界状态

$U_C=V_{cc}\cdot\xi=30\times0.96=28.8V$

$I_{cp}=G_{cr}U_{cemin}=G_{cr}(V_{cc}-V_c)=0.4\times1.2=0.48A$

$I_{c0}=I_{cp}\alpha_0(\varphi)=0.1528A$

$I_{c1}=I_{cp}\alpha_1\varphi=0.24A$

$\eta=\frac{P_o}{P_{DC}}=\frac{\frac{1}{2}I_{cp}\alpha_1(\varphi)V_c}{I_{cp}\alpha_0(\varphi)V_{cc}}=\frac{\alpha_1\varphi}{2\alpha_0\varphi}\xi=75.4\%$ 附录理论可以查得

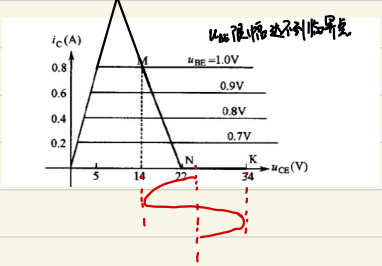
$P_o=\frac{1}{2}V_cI_{c1}=3.456W$

$R_T=\frac{V_c}{I_{c1}}=120\Omega$

$P_c=P_{DC}-P_o=1.128W$

基极电流幅度：	$I_{BP}=G_BU_b(1-\cos\varphi)$
集电极电流幅度：	$I_{CP}=g_mU_b(1-\cos\varphi)$
Q_T回路电压幅度：	$U_C=I_{CP}\alpha_1(\varphi)\cdot R_T=V_{CC}-U_{CE\min}$
c 极临界饱和电压：	$U_{CE\min}=\frac{I_{CP}}{G_{cr}}$
直流功率：	$P_{DC}=I_{C0}V_{CC}$
输出交流功率：	$P_o=I_{C1}U_c/2=I_{C1}^2R_T/2=U_c^2G_T/2$
电源利用系数：	$\zeta\equiv U_c/V_{CC}$
集电极效率：	$\eta_C=\frac{P_o}{P_{DC}}=\frac{1}{2}\frac{I_{CP}\alpha_1(\varphi)U_c}{I_{CP}\alpha_0(\varphi)V_{CC}}=\frac{1}{2}\frac{\alpha_1(\varphi)}{\alpha_0(\varphi)}\zeta$

3.12



(1) 为欠压状态 过压

(2) M(14V, 0.8A) N(22V, 0)

$V_{CC}=\frac{14V+34V}{2}=24V$

$V_c=V_{cc}-14V=10V$

$i_c=\frac{0.8A}{14-22}(u_{CE}-22V)$

$i_c=-0.1S(u_{CE}-22V)$

$-0.1S=-g_m\frac{V_b}{V_c}$

$g_mV_b=1S$

$A(24V, -g_mV_b\cos\varphi)$

$-g_mV_b\cos\varphi=-0.2A$

$\cos\varphi=\frac{1}{5}$

$\varphi=78.46°$

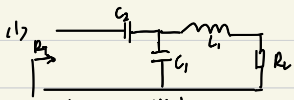
2) 欠压状态 故 R_T↑

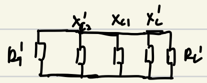
临界状态时 $V_c = V_{cc} - 5 = 19V$

$\xi = \frac{V_c}{V_{cc}} = \frac{19}{24}$ 导通角 φ 不变

$\eta_c = \frac{\alpha_1(\varphi)}{2\alpha_0(\varphi)} \xi \times 100\% = \frac{\varphi - \sin\varphi\cos\varphi}{2(\sin\varphi - \varphi\cos\varphi)} \times \frac{19}{24} \times 100\% \approx 65.78\%$

3.16 (1)





$Q_1 = \frac{|X_{C_2}|}{R_T}$ $Q_2 = \frac{|X_{L_1}|}{R_L}$

$X_{C_2}' = X_{C_2}(1+\frac{1}{Q_1^2})$ $X_L' = X_L(1+\frac{1}{Q_2^2})$

$R_T' = R_T(1+Q_1^2)$ $R_L' = R_L(1+Q_2^2)$

匹配条件 $R_T' = R_L' \Rightarrow Q_1 = \sqrt{\frac{R_L}{R_T}(1+Q_2^2) - 1} \Rightarrow C_2 = \frac{1}{\omega R_T Q_1}$

谐振条件: $\frac{1}{X_{C_1}} + \frac{1}{X_{C_2}'} + \frac{1}{X_L'} = 0$

$L_1 = \frac{Q_2 R_L}{\omega}$

$\therefore \frac{1}{j\omega C_1} = -(\frac{1}{X_{C_1}'} + \frac{1}{X_Q})^{-1}$

(2) $Q_2 = 4$ 则 $Q_1 = 2.408$

$C_2 = 5.29\ pF$

$L_1 = 1.27\ \mu H$

$C_1 = 2.98\ pF$