UNIVERSITY EXAMINATIONS

UNIVERSITEITSEKSAMENS

UNISA university of south africa

ECT2601
RCT2601

October/November 2016

ELECTRONICS II (THEORY)

Duration 3 Hours

100 Marks

EXAMINERS .
FIRST MR PO UMENNE
SECOND MR NR NETSHIKWETA

Programmable pocket calculator is permissible

Closed book examination

This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue

This examination question paper consists of 9 pages including this "cover" plus 4 pages formulae sheets

Answer all questions

PLEASE NOTE: IF YOU HAVE THE OPINION THAT INSUFFICIENT INFORMATION IS SUPPLIED FOR YOU TO ANSWER A PARTICULAR QUESTION, MAKE A REALISTIC ASSUMPTION, MOTIVATE IT AND THEN ANSWER THE QUESTION.

BIPOLAR JUNCTION TRANSISTOR

QUESTION 1

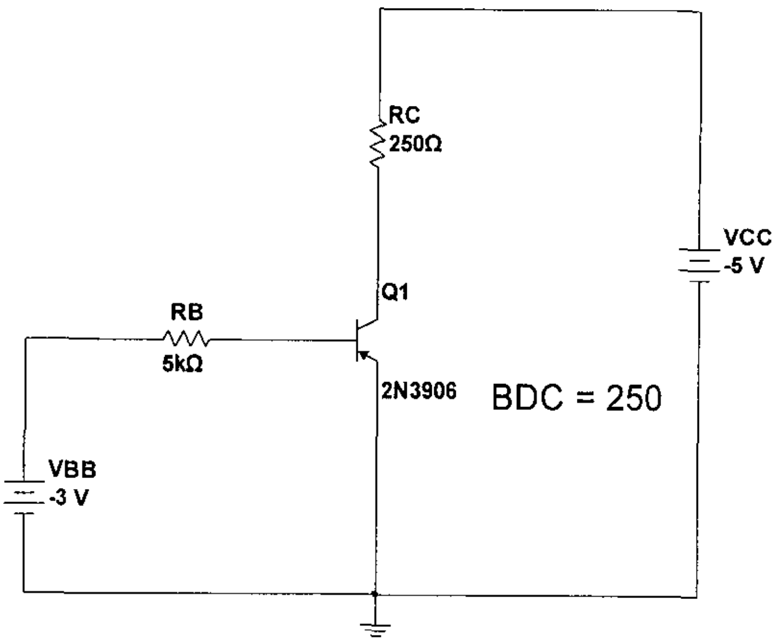

Figure 1

1.1 Calculate the V_{CE} for the pnp transistor in figure 1 (6)

1.2 Determine if the transistor is saturated. (4)

[10]

TRANSISTOR BIAS CIRCUITS

QUESTION 2

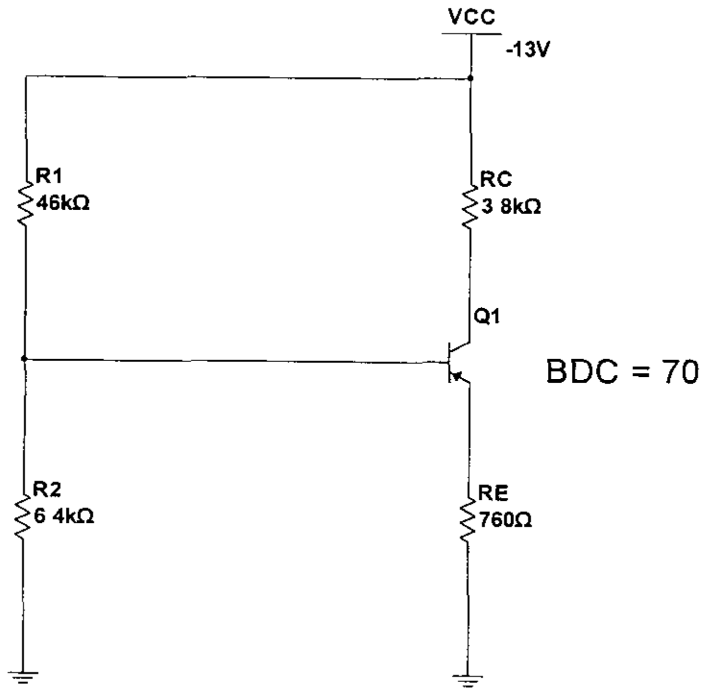

Figure 2

Calculate I_C and V_{CE} for the pnp divider circuit in figure 2. **[8]**

[TURN OVER]

QUESTION 3

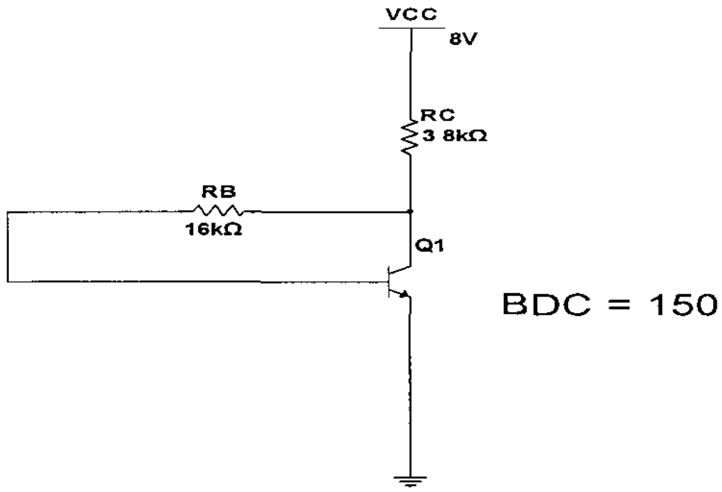

Figure 3

3 1 Determine $V_B, V_C, and\ I_C$ in the collector feedback bias circuit in figure 3 above (6)

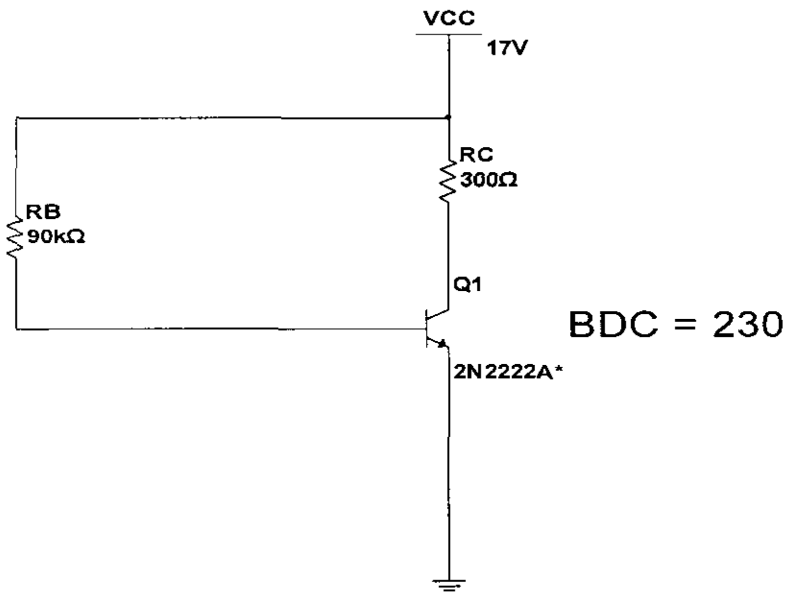

Figure 4

3 2 Determine $I_B, I_C, and\ V_{CE}$ for the base-biased transistor circuit in figure 4 above (6)

[12]

[TURN OVER]

BJT AMPLIFIERS

QUESTION 4

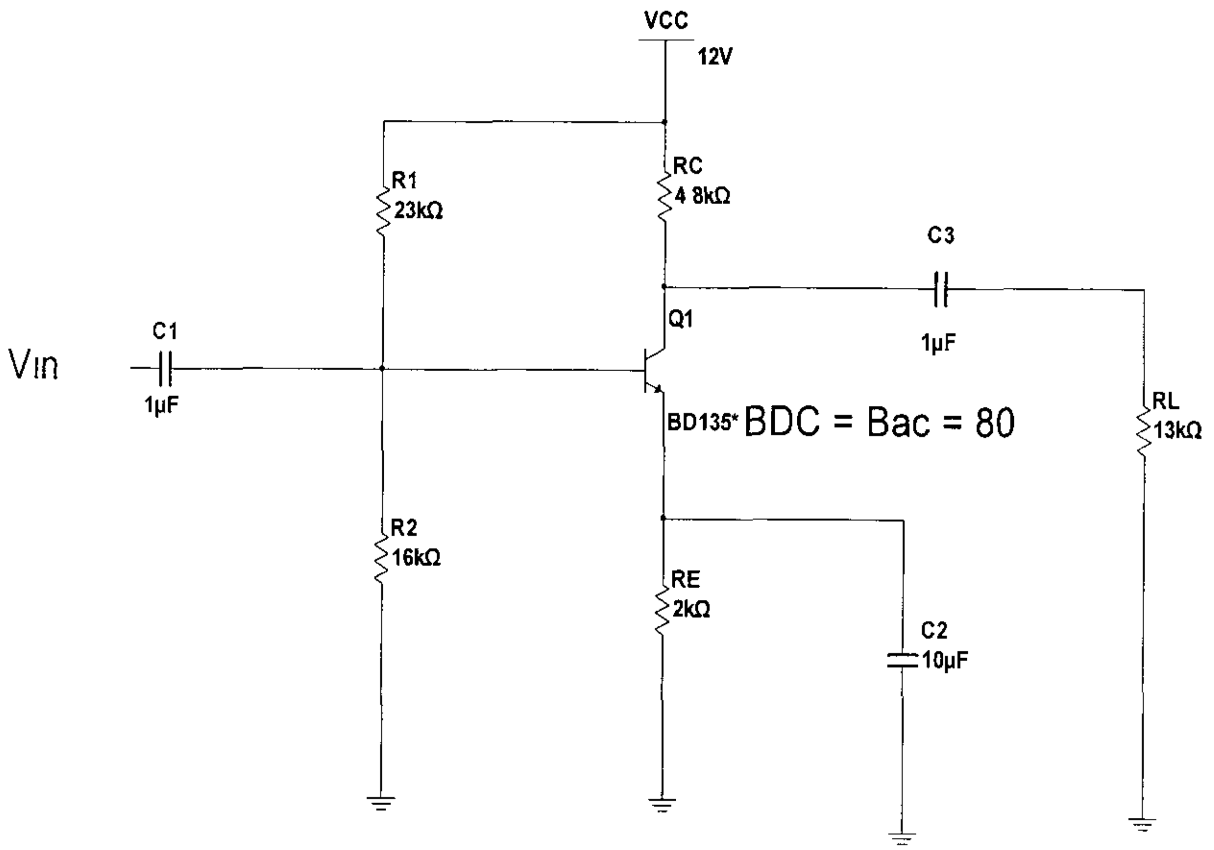

Figure 5

Determine the following values for the amplifier in figure 5 above

4 1 $R_{in(base)}$ (10)

4 2 $R_{in(tot)}$ (2)

4 3 A_v (2)

[14]

QUESTION 5

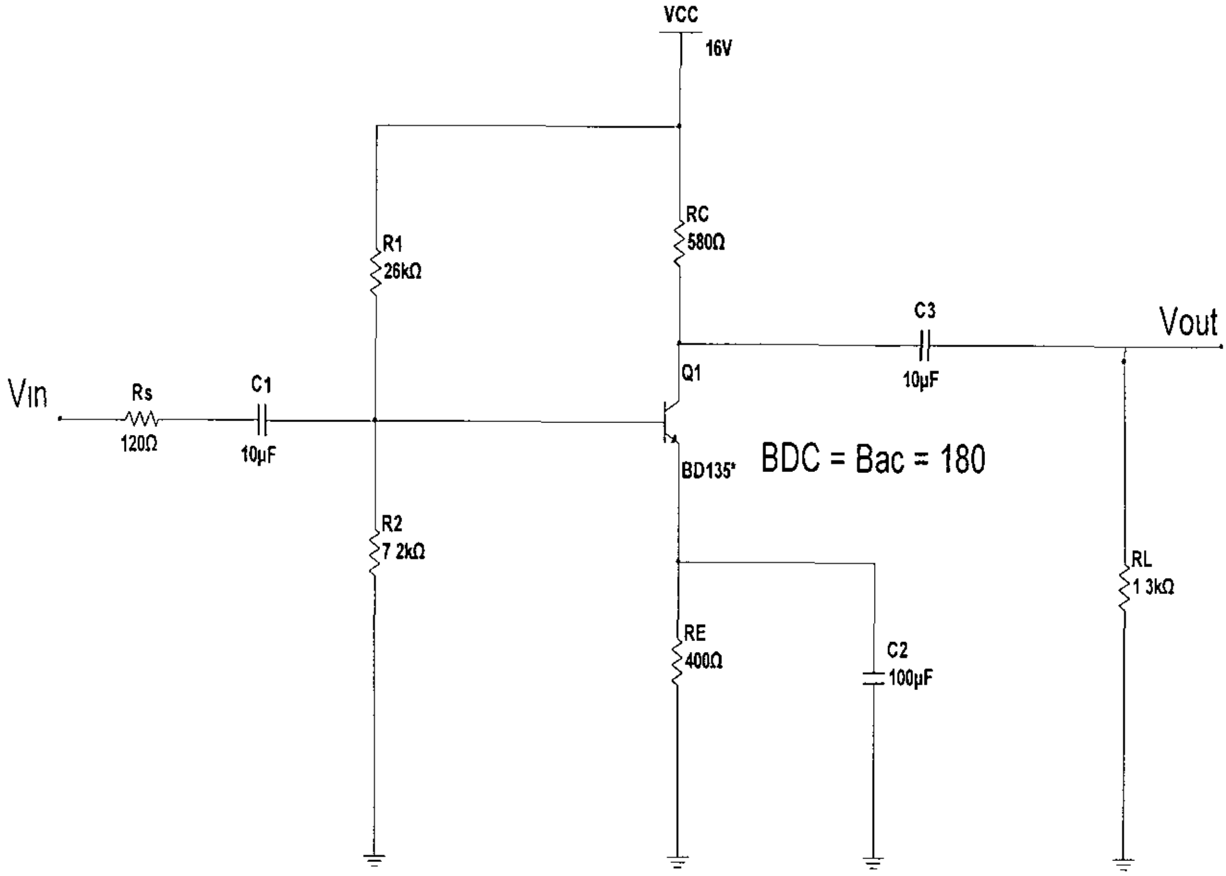

Figure 6

Calculate the overall voltage gain for the amplifier in figure 6 with a load $R_L = 1\ 3k\Omega$, if it is driven by a 120Ω source **[16]**

QUESTION 6

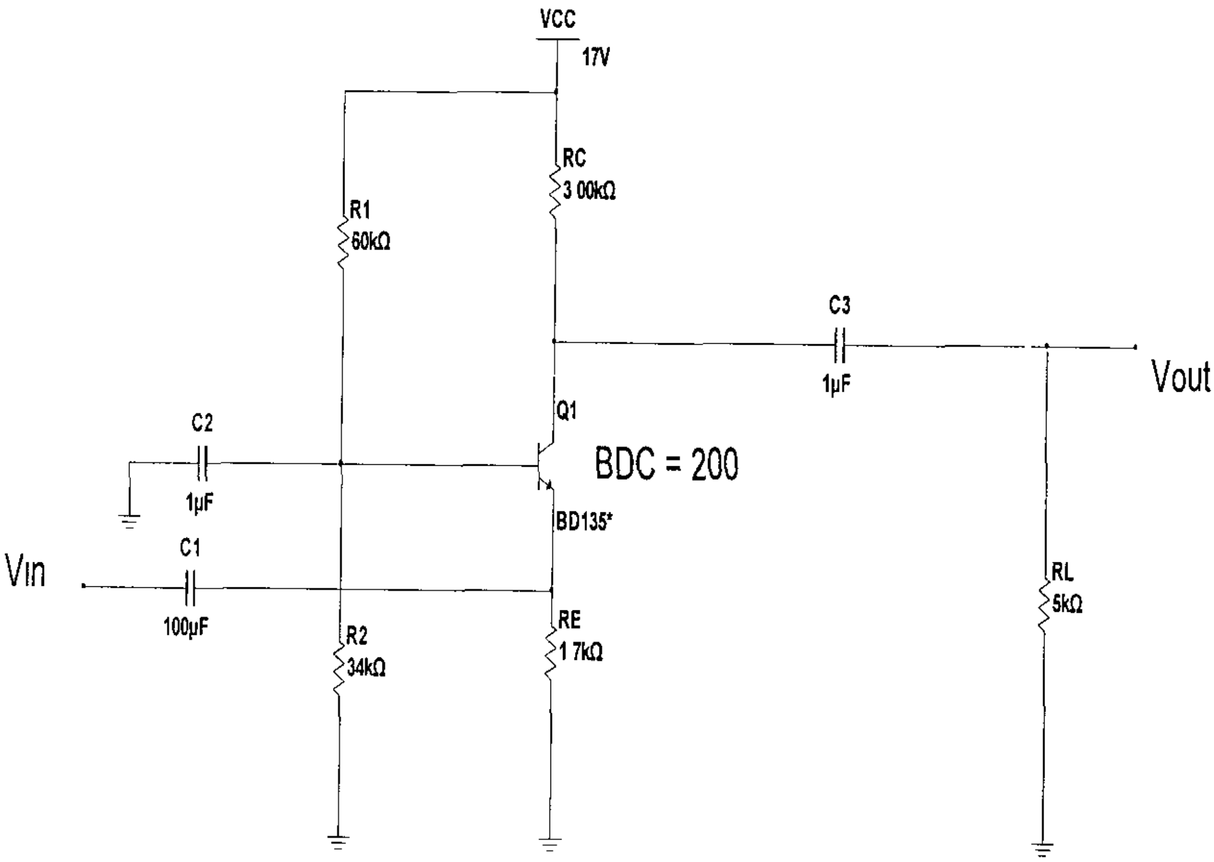

Figure 7

6 1 Calculate the input resistance R_{in} for the common base amplifier in figure 7 above (8)

6 2 Calculate the voltage gain A_v (2)

[10]

QUESTION 7

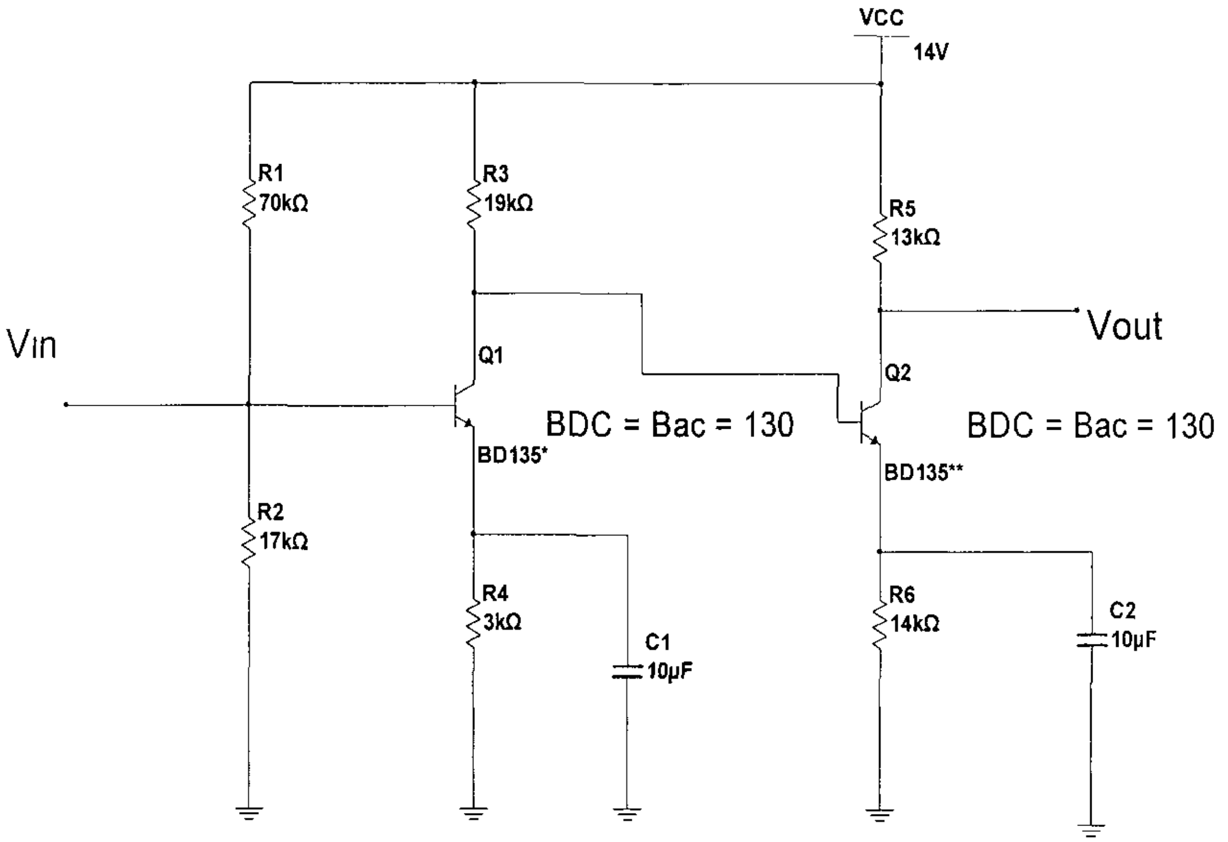

Figure 8

7 1 For the direct-coupled two stage amplifier in figure 8 above determine all the dc voltages for both stages (18)

7 2 Calculate the overall ac voltage gain (6)

[24]

FIELD EFFECT TRANSISTORS

QUESTION 8

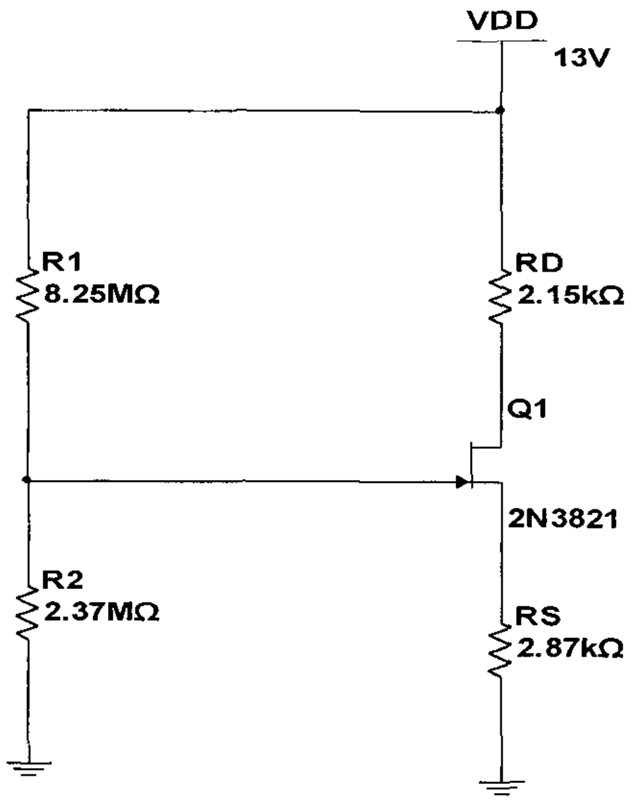

Figure 9

Determine I_D and V_{GS} for the JFET with voltage-divider bias in figure 9 above given that for this particular JFET the parameter values are such that $V_D = 9V$. **[6]**

Total Marks [100]

Formula Sheet

$V_{RIP(p\text{-}p)} = \left(\dfrac{V_{DC}}{2fCR_L}\right)$

$V_{RIP(p\text{-}p)} = \left(\dfrac{V_{DC}}{CfR_L}\right)$

$X_C = \dfrac{1}{2\pi fC}$

$V_{DC} = V_{pk} - \dfrac{1}{2}V_{RIP(p-p)}$

$I_B = \dfrac{V_{CC} - V_{BE}}{R_B + (\beta + 1)R_E}$

$V_{TH} = V_{CC}\left(\dfrac{R_{B2}}{R_{B1} + R_{B2}}\right)$

$\dfrac{V_{sec}}{V_{pri}} = \dfrac{N_{sec}}{N_{pri}}$

$\dfrac{I_{pri}}{I_{sec}} = \dfrac{N_{sec}}{N_{pri}}$

$r = \left(\dfrac{V_r}{V_{DC}}\right)$

$I_{B(min)} = \dfrac{I_{C(sat)}}{\beta_{DC}}$

$R_{TH} = \left(\dfrac{R_{B1} \times R_{B2}}{R_{B1} + R_{B2}}\right)$

$V_B \cong \left(\dfrac{R_2}{R_1 + R_2}\right)V_{CC}$

$A_v \cong \dfrac{R_C}{R_E}$

$A_v = \dfrac{R_C}{r'_e}$

$I_{ZM} = \dfrac{P_{D(max)}}{V_Z}$

$R_{in} = R_G \left\| \left(\dfrac{V_{GS}}{I_{GSS}}\right)\right.$

$I_D = I_{DSS}\left(1 - \dfrac{V_{GS}}{V_{GS(off)}}\right)^2$

$V_B = \left(\dfrac{R_2 \| \beta_{DC} R_E}{R_1 + (R_2 \| \beta_{DC} R_E)}\right)V_{CC}$

$V_r = \left(\dfrac{1}{fR_L C}\right)V_{p(rect)}$

$V_{DC} = \left(1 - \dfrac{1}{2fR_L C}\right)V_{p(rect)}$

$R_{surge} = \dfrac{V_{p(sec)} - 1\ 4V}{I_{FSM}}$

$Z_Z = \dfrac{\Delta V_Z}{\Delta I_Z}$

$V_{AVG} = \dfrac{V_p}{\pi}$

$\beta_{DC} = \dfrac{\alpha_{DC}}{1 - \alpha_{DC}}$

$r'_c = \dfrac{h_{re} + 1}{h_{oe}}$

$r'_b = h_{ie} - \dfrac{h_{re}}{h_{oe}}(1 + h_{fe})$

$r'_e \cong \dfrac{25mV}{I_E}$

$A'_v = \left(\dfrac{V_b}{V_s}\right)A_v$

$A_v = \dfrac{R_C}{r'_e + R_E}$

$A_i = \dfrac{I_c}{I_s}$

$g_m = g_{m0}\left(1 - \dfrac{V_{GS}}{V_{GS(off)}}\right)$

$g_{m0} = \dfrac{2I_{DSS}}{|V_{GS(off)}|}$

$R_{in} = \left|\dfrac{V_{GS}}{I_{GSS}}\right|$

$V_G = \left(\frac{R_2}{R_1 + R_2}\right)V_{DD}$ $I_D = \frac{V_G - V_{GS}}{R_S}$ $A_v = \frac{V_{ds}}{V_{gs}}$

$R_S = \left|\frac{V_{GS}}{I_D}\right|$ $A_v = g_m\left(\frac{R_d r'_{ds}}{R_d + r'_{ds}}\right)$ $A_v = \frac{g_m R_d}{1 + g_m R_s}$

$I_D = \frac{I_{DSS}}{2}$ $I_D = I_{DSS}\left(1 - \frac{I_D R_S}{V_{GS(off)}}\right)^2$ $f = \frac{1}{T}$

$A_{cl(NI)} = 1 + \frac{R_f}{R_i}$ $V_{LTP} = \frac{R_2}{R_1 + R_2}(-V_{out(\max)})$ $A_{cl(I)} = -\frac{R_f}{R_i}$

$V_{out} = -\left(\frac{V_C}{t}\right)R_f C$ $\frac{\Delta V_{out}}{\Delta t} = -\frac{V_{in}}{R_i C}$ $V_{UTP} = \frac{R_2}{R_1 + R_2}(+V_{out(\max)})$

$F = \frac{kQ_1Q_2}{d_2}$ $V_x = \left(\frac{C_T}{C_X}\right)V_S$ $L = \frac{N^2 \mu A}{I}$

$V_{OUT} = V_{REF}(1 + \frac{R_2}{R_1}) + I_{ADJ}R_2$ $L_M = k\sqrt{L_1 L_2}$ $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \quad \frac{1}{L_n}$

Percent load regulation = $\frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$ Percent line regulation = $\frac{\Delta V_{OUT}}{\Delta V_{IN}} \times 100\%$

$V_{OUT} = -\frac{R_f}{R}(V_{IN1} + V_{IN2} + \quad + V_{INn})$ $V_{OUT} = -\left(\frac{R_f}{R_1}V_{IN1} + \frac{R_f}{R_2}V_{IN2} + \quad + \frac{R_f}{R_n}V_{INn}\right)$

$\%distortion_{NEW} = \%distortion_{ORIGINAL}/[1 + (\beta*A)]$ $Z_{OUT}(new) = Z_{OUT}(original)/[1 + (\beta*A)]$

$Z_{OUT}(new) = Z_{OUT}(original) * [1 + (\beta*A)]$ $Z_{IN}(new) = Z_{in}(original) * [1 + (\beta*A)]$

$Z_{IN}(new) = Z_{IN}(original)/[1 + (\beta*A)]$ $f_0 = 1/[2\pi*\sqrt{(L*C)}]$

Modulation depth = [(signal peak)/(carrier peak)]*100% BW = LSB + USB

$A_d = -[(h_{fe}*R_C)/\{2*(R_b + h_{ie})\}]$ $BW_{NEW} = BW_{ORIGINAL} + [1 + (\beta*A)]$

$A_V(dB) = A_{V1}(dB) + A_{V2}(dB) + \quad + A_{Vn}(dB)$ $A'_V = A_{V1}A_{V2}A_{V3} \quad A_{Vn}$

$A_P = \beta_{DC}A_V$ $fr = 1/2\pi\sqrt{LC}$

$V_{DS} = V_{DD} - I_{DSS}R_D$

$P_{out} = V_{rms(out)}I_{rms(out)}$

$eff = P_{OUT}/P_{OUT} + P_{D(AVG)}$

$V_b = h_{ie}I_B$

$\beta = \beta_1\beta_2$

$V_b = V_c h_{re}$

$I_c = I_b h_{fe}$

$I_c = V_c h_{oe}$

$h_{re} = h_{oe}r'_e$

$P_{D(derated)} = P_{D(max)} - (mW/C°)\Delta T$

$R_{in(base)} = \beta_{ac}r'_e$

$R_{in(tot)} = R_1//R_2//R_{IN(BASE)}$

$R_{in(base)} = \beta_{ac}(r'_e + R_{E1})$

$A_p = A'_v A_i$

$A_v\ (db) = 20 \log A_v$

$V_{GS} = -I_D R_S$

$I_d = g_m V_{gs}$

$A_v = g_m R_d$

$V = I \times R$

$S = V \times I \times \cos\theta$

$dB = 10 \log A_P$

$V_{OUT} = -(V_{IN1} + V_{IN2} + \quad +V_{Inn})$

$A_{cl(VF)} = 1$

$V_{HYS} = V_{UTP} - V_{ITP}$

$V_{DS} = V_{DD} - I_{DSS}R_D$

$R_{IN} \cong \beta_{DC}R_E$

$V_{GS} = +I_D R_S$

$R_{IN(base)} \cong \beta_{DC}R_E$

$Q = 1{,}6 \times 10^{-19}\ C$

$\Delta V_Z = V_Z \times TC \times \Delta T$

$R_{in} = R_1 \| R_2 \| R_{IN(gate)}$

$A_f = A/[1 + (\beta * A)$

$Z_{IN} = h_{ie} + (h_{fe} + 1)*r_{e2}$

$F_0 = \sqrt{}(f_1 * f_2)$

$BW = f_2 - f_1$

$Q = f_0/BW$

$f_0 = [1/[(2\pi)*(\sqrt{}\{(1/L*C) - (R^2/L^2)\}]$

$Q = [\sqrt{}L/(C*R^2)] - 1$

$R_p = (\omega_0{}^2*L^2)/R_s$

$R_s = (\omega_0{}^2*L^2)/R_p$

$Q = (1/R)* \sqrt{}(L/C)$

$Q_L = (\omega_0*L)/R_X$

$Q_C = 1/(\omega_0*C)$

$R_0 = \sqrt{}(L/C)$

$f_C = 1/(\pi*\sqrt{}L*C)$

$F_C = 1/4\pi*\sqrt{}L*C)$

$C = C_N/(2\pi*f_C*R)$

$L = (R*L_N)/(2\pi*f_C)$

$A_0 = 3 - P$

$A_0 = (R_1 = R_2)/R_1$

$f_C = 1/(2\pi*R*C)$

$L = F*N^2*D$

F = lower point + (Z*(X/Y)

$Z_1 = Z^I/(1 - A_V)$

$Z_2 = (Z^I*A_V)/(A_V - 1)$

$A_I = hf/[1 + (h_0*Z_L)]$

$A_V = (A_I/Z_I)*Z_L$

$Z_I = h_I + (h_r*A_I*Z_L)$

$Y_0 = 1/Z_0 = h_0 - [(h_f*h_r)/(h_I + R_S)]$

$V = IX_C$

$L_T = L_1 + L_2 + L_3 + \quad L_n$

$X_L = 2\pi f L$

$V = IX_L$