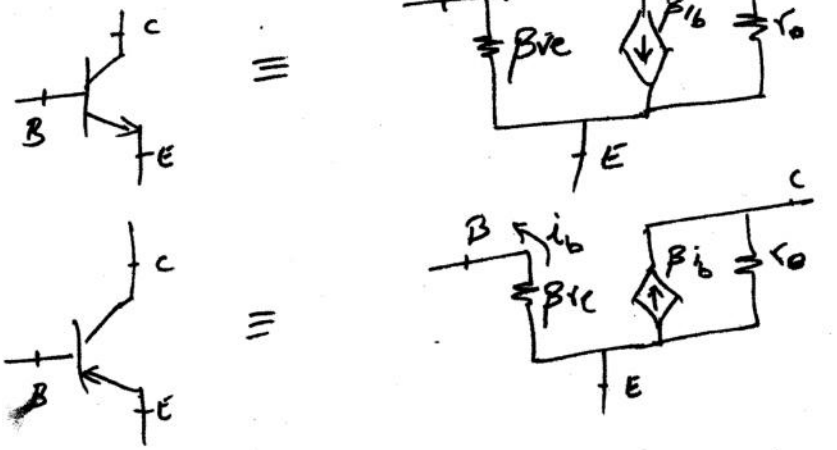
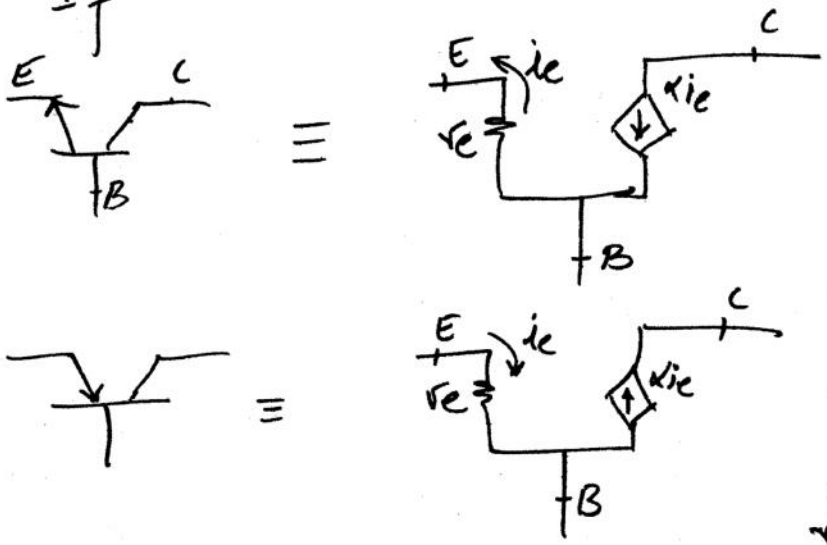
BJT PREREQUISITES

If C-E or C-C the A.C. Model will be

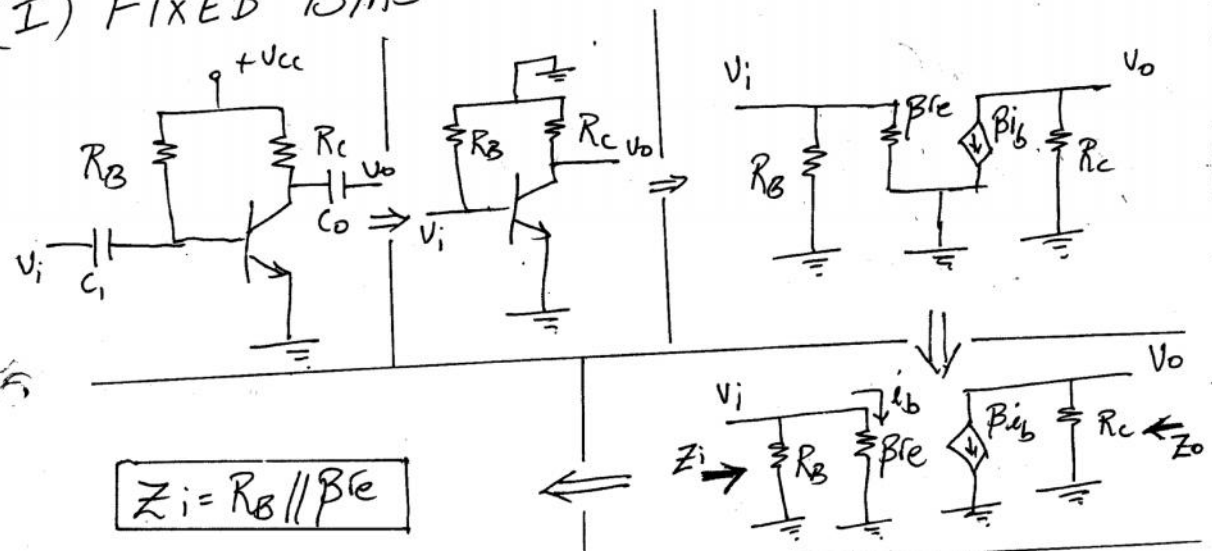


If C-B then the A.C. Model is



$r_e = \frac{26mV}{I_{CQ}}$

(I) FIXED BIAS



$$Z_i = R_B \parallel \beta r_e$$

$$Z_o = R_c$$

$$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b R_c}{i_b \beta r_e}$$

$$A_v = \frac{-R_c}{r_e}$$

$$A_i = \frac{-A_v Z_i}{R_c}$$

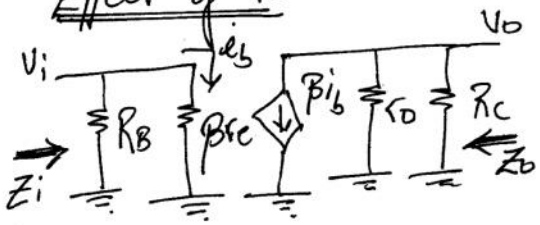
$Z_i = R_B \parallel \beta r_e \quad Z_o = R_c \parallel r_o$

$$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_c \parallel r_o)}{i_b \beta r_e}$$

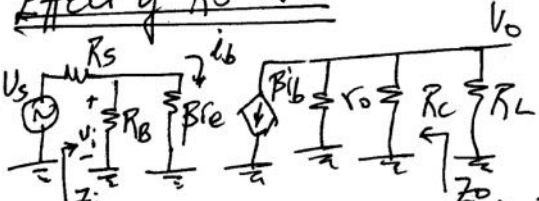
$$A_v = \frac{-R_c \parallel r_o}{r_e}$$

$$A_i = \frac{-A_v Z_i}{R_c}$$

Effect of r_o:



Effect of R_s & R_L:



$Z_i = R_B \parallel \beta r_e$

$Z_o = r_o \parallel R_c$

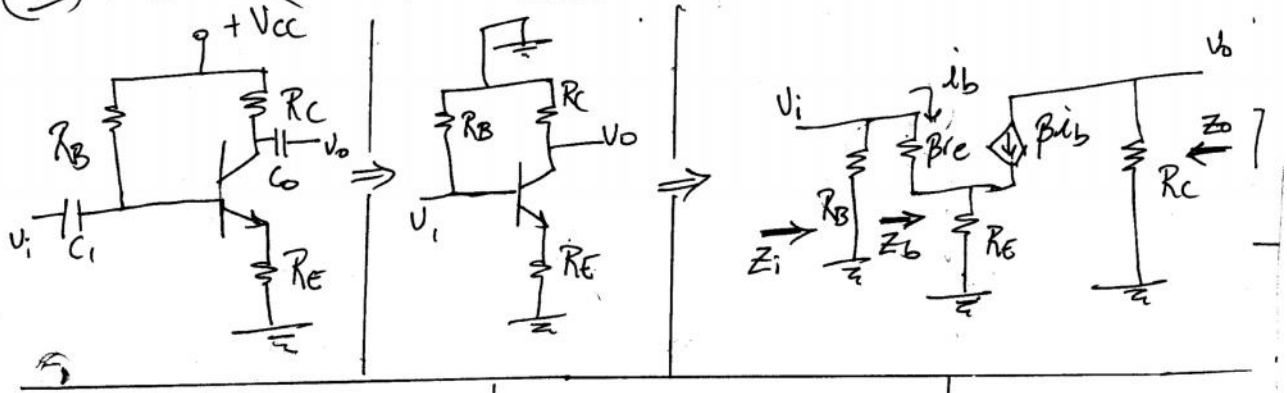
$$A_v = \frac{V_o}{V_i} = \frac{-R_c \parallel r_o \parallel R_L}{r_e}$$

$$A_{vs} = \frac{+A_v Z_i}{Z_i + R_s}$$

$$A_i = \frac{-A_v Z_i}{R_L}$$

$$A_{is} = \frac{-A_{vs}(Z_i + R_s)}{R_L}$$

(II) EMITTER - STABILIZED BIAS



$Z_i = R_B \parallel Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$\cong \beta (r_e + R_E)$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b R_C}{i_b Z_b}$

$A_v = -\frac{R_C \beta}{Z_b}$

$A_v \cong -\frac{R_C}{r_e + R_E}$

$A_i = -\frac{A_v Z_i}{R_C}$

$Z_i = R_B \parallel Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$\cong \beta (r_e + R_E)$

$A_v = \frac{V_o}{V_i} \cong \frac{-\beta i_b (R_C \parallel R_L)}{i_b Z_b}$

$A_v \cong -\frac{(R_C \parallel R_L)}{r_e + R_E}$

$A_i = -\frac{A_v Z_i}{R_C}$

$Z_i = R_B \parallel Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$\cong \beta (r_e + R_E)$

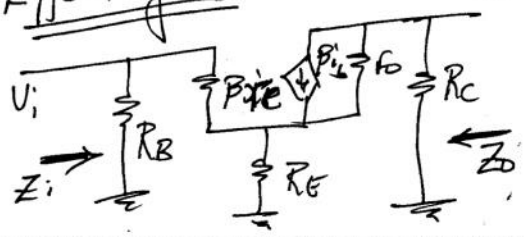
$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_C \parallel R_L)}{i_b Z_b}$

$A_v \cong -\frac{(R_C \parallel R_L)}{r_e + R_E}$

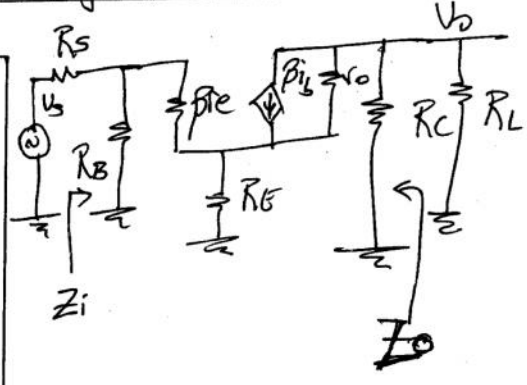
$A_{vs} = \frac{Z_i}{Z_i + R_S} A_v$

$A_{is} = -\frac{A_v (Z_i + R_S)}{R_L}$

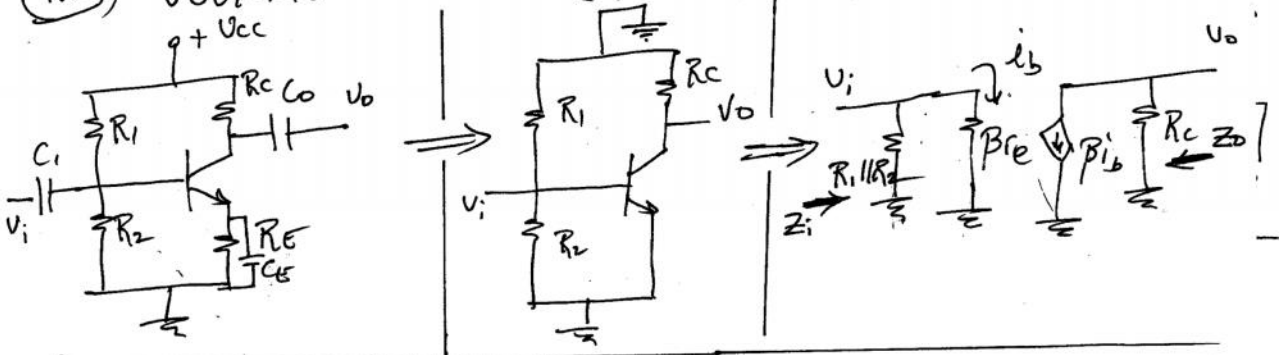
Effect of r_o :



Effect of R_S & R_L :



(III) VOLTAGE - DIVIDER BIAS :



$Z_i = R_1 \| R_2 \| \beta r_e$

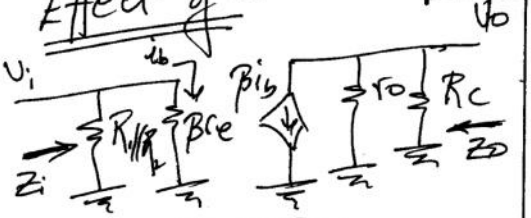
$Z_o = R_c$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_c)}{\beta r_e i_b}$

$A_v = \frac{-R_c}{r_e}$

$A_i = \frac{-A_v Z_i}{R_c}$

Effect of r_o :



$Z_i = R_1 \| R_2 \| \beta r_e$

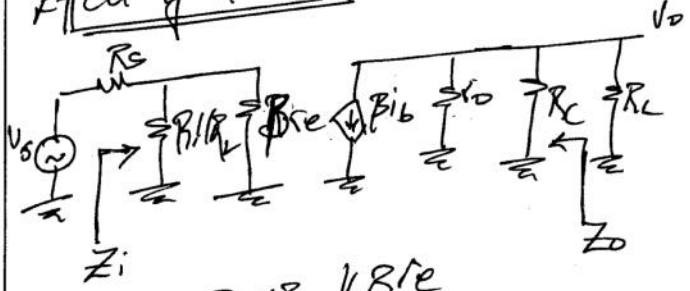
$Z_o = R_c \| r_o$

$A_v = +\frac{V_o}{V_i} = \frac{-\beta i_b (R_c \| r_o)}{\beta r_e i_b}$

$A_v = \frac{-R_c \| r_o}{r_e}$

$A_i = \frac{-A_v Z_i}{R_c}$

Effect of R_s & R_L :



$Z_i = R_1 \| R_2 \| \beta r_e$

$Z_o = R_c \| r_o$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_c \| r_o \| R_L)}{i_b \beta r_e}$

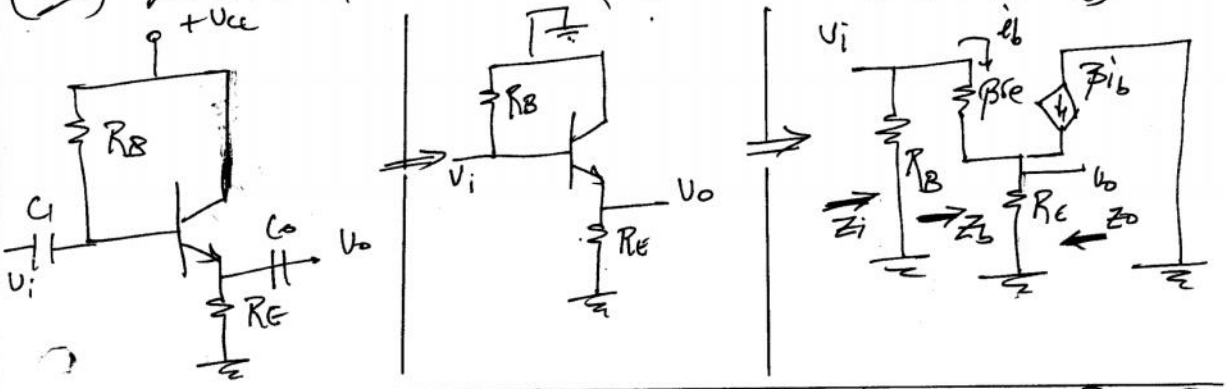
$A_v = \frac{-R_c \| r_o \| R_L}{r_e}$

$A_{vs} = \frac{Z_i}{Z_i + R_s} A_v$

$A_i = \frac{-A_v Z_i}{R_L}$

$A_{is} = \frac{-A_{vs} (Z_i + R_s)}{R_L}$

(IV) EMITTER FOLLOWER (COMMON COLLECTOR):



$Z_i = R_B \| Z_b$

$Z_b = \beta r_e + (1+\beta) R_E$

$Z_o \cong \frac{\beta r_e}{1+\beta} \| R_E$

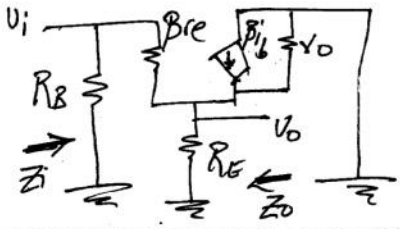
$\cong r_e \| R_E$

$A_v = \frac{V_o}{V_i} = \frac{+(1+\beta) i_b R_E}{i_b Z_b}$

$A_v \cong \frac{R_E}{R_E + r_e} \cong 1$

$A_i = \frac{-A_v Z_i}{R_E}$

Effect of r_o:



$Z_i = R_B \| Z_b$

$Z_b = \beta r_e + (1+\beta) R_E'$

$\cong \beta (r_e + R_E')$ $\quad R_E' = R_E \| r_o$

$Z_o = \frac{\beta r_e}{1+\beta} \| R_E \| r_o$

$A_v = \frac{V_o}{V_i} = \frac{(1+\beta) i_b (R_E \| r_o)}{i_b Z_b}$

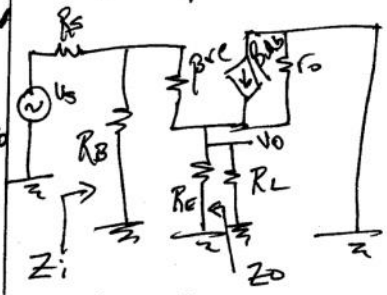
$\cong \frac{R_E \| r_o}{R_E' + r_e}$

$A_i = \frac{-A_v Z_i}{R_E}$

$A_{is} = \frac{-A_{vs}(Z_i + R_s)}{R_L}$

$A_i = \frac{-A_v Z_i}{R_L}$

Effect of R_s & R_L



$Z_i = R_B \| Z_b$

$Z_b = \beta r_e + (1+\beta) \times (R_E' \| R_L)$

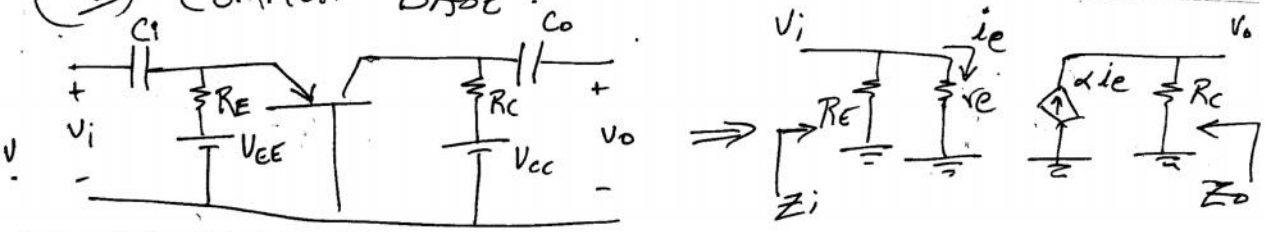
$A_v = \frac{V_o}{V_i} = \frac{+(1+\beta) i_b \cdot (R_E \| R_L \| r_o)}{i_b Z_b}$

$A_v = \frac{R_E \| R_L \| r_o}{R_E' \| R_L + r_e}$

$Z_o = \left[\frac{R_s \| R_B + \beta r_e}{1+\beta} \right] \| R_E \| r_o$

$A_{vs} = \frac{Z_i}{Z_i + R_s} \cdot A_v$

(V) COMMON BASE:



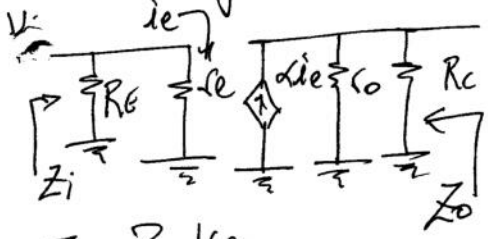
$Z_i = R_E \| r_e$

$Z_o = R_C$

$A_V = \frac{\alpha i_e R_C}{i_e r_e} = \frac{\alpha R_C}{r_e}$

$A_i = \frac{-A_V Z_i}{R_C}$

Effect of r_o



$Z_i = R_E \| r_e$

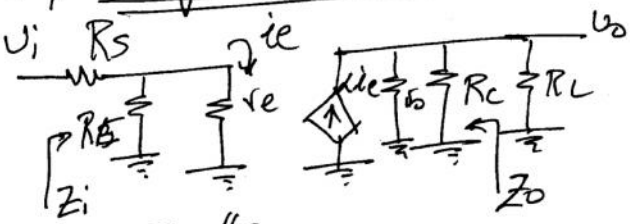
$Z_o = R_C \| r_o$

$A_V = \frac{V_o}{V_i} = \frac{\alpha i_e (R_C \| r_o)}{i_e r_e}$

$A_V = \frac{\alpha (R_C \| r_o)}{r_e}$

~~$A_i = \frac{-A_V Z_i}{R_C}$~~

Effect of R_S & R_L:



$Z_i = R_E \| r_e$

$Z_o = R_C \| r_o$

$A_V = \frac{V_o}{V_i} = \frac{+\alpha i_e (R_C \| R_L \| r_o)}{i_e r_e}$

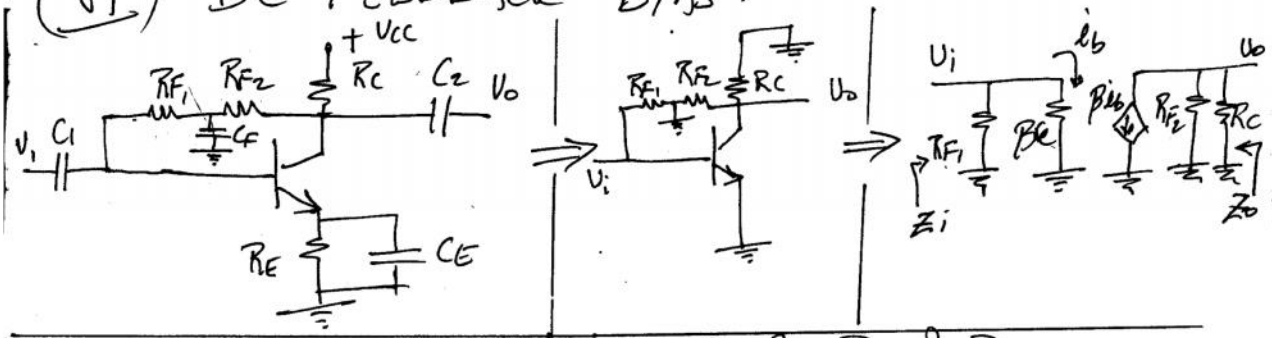
$A_V = \frac{\alpha (R_C \| R_L \| r_o)}{r_e}$

$A_{V_S} = \frac{Z_i}{Z_i + R_S} \cdot A_V$

$A_i = \frac{-A_V Z_i}{R_L}$

$A_{i_S} = \frac{-A_{V_S} (Z_i + R_S)}{R_L}$

(VI) DC FEEDBACK BIAS :



$Z_i = R_{F_1} \,//\, \beta r_e$

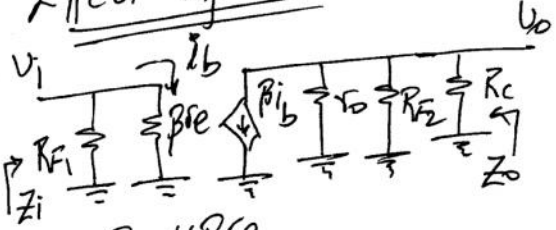
$Z_o = R_C \,//\, R_{F_2}$

$A_v = \frac{V_o}{V_i} = \frac{-\beta i_b (R_C \,//\, R_{F_2})}{i_b (\beta r_e)}$

$A_v = \frac{-(R_C \,//\, R_{F_2})}{r_e}$

$A_i = \frac{-A_v Z_i}{R_C}$

Effect of r_o :



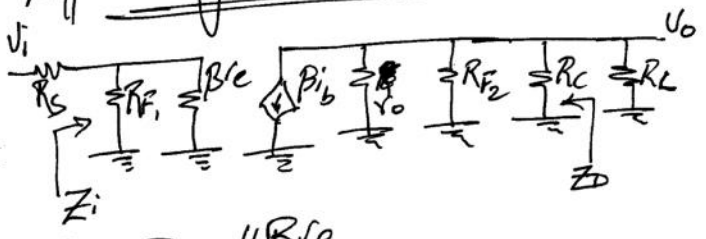
$Z_i = R_{F_1} \,//\, \beta r_e$

$Z_o = R_C \,//\, R_{F_2} \,//\, r_o$

$A_v = \frac{-V_o}{V_i} = \frac{-R_C \,//\, R_{F_2} \,//\, r_o}{r_e}$

$A_i = \frac{-A_v Z_i}{R_C}$

Effect of R_S & R_L



$Z_i = R_{F_1} \,//\, \beta r_e$

$Z_o = r_o \,//\, R_{F_2} \,//\, R_C$

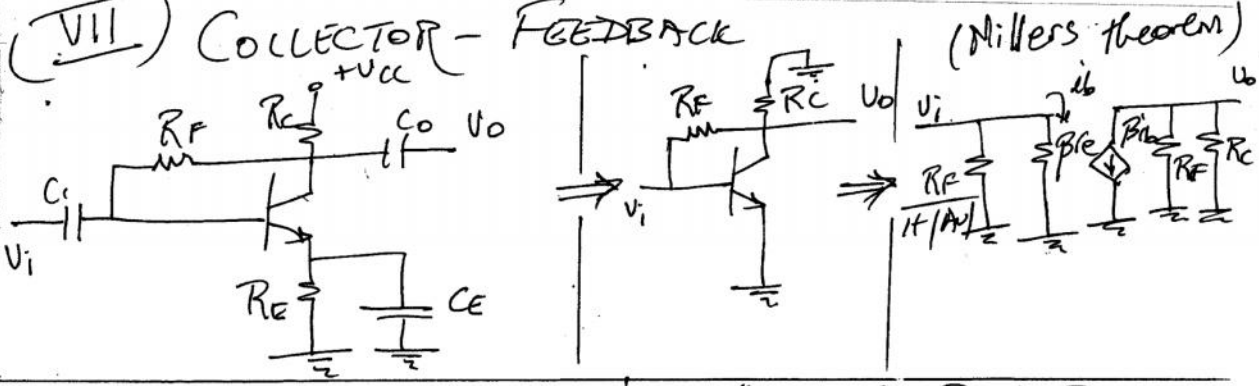
$A_v = \frac{-V_o}{V_i} = \frac{-(R_C \,//\, R_{F_2} \,//\, r_o \,//\, R_L)}{r_e}$

$A_{v_S} = \frac{+A_v Z_i}{Z_i + R_S}$

$A_i = \frac{-A_v Z_i}{R_L}$

$A_{i_S} = \frac{-A_{v_S} (Z_i + R_S)}{R_L}$

(VII) COLLECTOR – FEEDBACK (Millers theorem)



$$A_V = \frac{+V_o}{V_i} = \frac{-\beta i_b (R_C \parallel R_F)}{i_b (\beta r_e)}$$

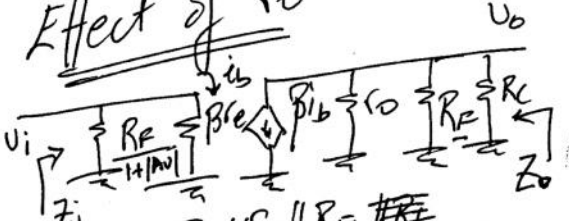
$$A_V = -\left(\frac{R_C \parallel R_F}{r_e}\right)$$

$$A_i = \frac{-A_V Z_i}{R_C}$$

$$Z_i = \left(\frac{R_F}{1+|A_V|}\right) \parallel \beta r_e$$

$$Z_o = R_C \parallel R_F$$

Effect of r_o



$$A_V = \frac{-R_C \parallel r_o \parallel R_F}{r_e}$$

$$A_i = \frac{-A_V Z_i}{R_C}$$

$$Z_i = \left(\frac{R_F}{1+|A_V|}\right) \parallel \beta r_e \qquad Z_o = R_C \parallel R_F \parallel r_o$$

Effect of R_S & R_L

$$Z_i = \left(\frac{R_F}{1+|A_V|}\right) \parallel \beta r_e$$

$$Z_o = R_C \parallel R_F \parallel r_o$$

$$A_V = \frac{-(R_C \parallel R_F \parallel r_o \parallel R_L)}{r_e}$$

$$A_{VS} = \frac{Z_i}{Z_i + R_S} A_V$$

$$A_i = \frac{-A_V Z_i}{R_L}$$

$$A_{iS} = \frac{-A_{VS}(Z_i + R_S)}{R_L}$$