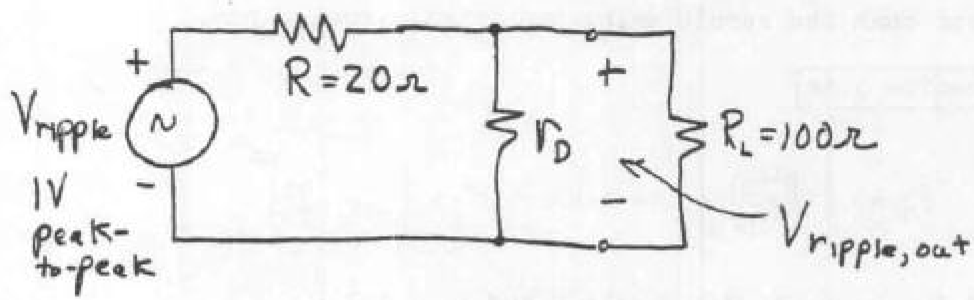
Problem 3.60

$I_L = V_L/R_L = 5/100 = 50$ mA

$I_{source} = (8 - 5)/20 = 150$ mA

$I_{QZenner} = I_{source} - I_L = 100$ mA

Small-signal equivalent circuit:



Let $R'_L = R_L || r_d$, then we can write:

$$V_{ripple,out} = 10 \text{ mV} = (1 \text{ V}) \times \frac{R'_L}{R'_L + R}$$

Solving we find $R'_L = 0.202\ \Omega$. Thus we have $R'_L = 0.202 = \frac{1}{1/r_d + 1/R_L}$ which yields $r_d = 0.202\ \Omega$.

Problem 4.11

$$I_{B2} + I_{C1} + I_{B1} = 1 \text{ mA}$$

Because the transistors are identical and have equal V_{BE}, we conclude that $I_{B2} = I_{B1}$ and $I_{C2} = I_{C1}$. Furthermore $I_{C1} = \beta I_{B1}$.

$$I_{B1} + 100I_{B1} + I_{B1} = 1 \text{ mA} \quad \Rightarrow \quad I_{B1} = 9.804\ \mu\text{A}$$

$$I_{C1} = I_{C2} = \beta I_{B1} = 0.9804 \text{ mA}$$

$$I_{E1} = (\beta + 1)I_{B1} = 0.9902 \text{ mA}$$

Solving Equation 4.1 for V_{BE} we have

$$V_{BE} = V_T \ln(I_E/I_{ES} + 1)$$

$$= 0.026\ln[(0.9902 \times 10^{-3})/10^{-14} + 1]$$

$$= 0.6583 \text{ V}$$

Problem 4.28

(a) Active.
(b) Cutoff.
(c) Cutoff.
(d) Saturation.

Problem 4.33

Circuit	β	Region	I_C (mA)	V_{CE} (V)
(a)	100	active	1.93	10.9
(a)	300	saturation	4.21	0.2
(b)	100	active	1.47	5.00
(b)	300	saturation	2.18	0.2
(c)	100	cutoff	0	15
(c)	300	cutoff	0	15
(d)	100	active	6.5	8.5
(d)	300	saturation	14.8	0.2