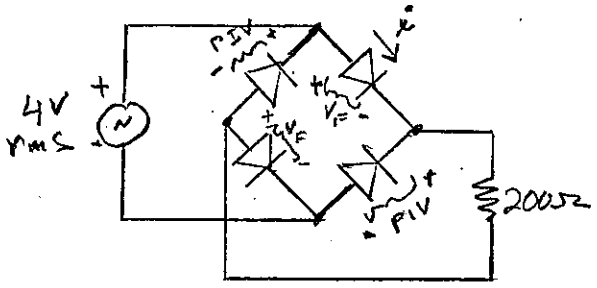
ECE 252 | **Introduction to Electrical Engineering** | **Quiz 17P**
100 Points | **Show your work.** | Solution | **Practice**

1. (35) Sketch and label the circuit for a full-wave rectifier. You have a 4 V rms, 60 Hz power supply, four silicon diodes, and a 200 Ω load. What is the maximum current in any diode? What is the minimum PIV of the diodes?



The maximum current will occur when the source voltage is highest:

$V_{max} = 4\sqrt{2} = 5.66$ V.

KVL for forward voltage:

$-5.66 + V_F + I_{max}(200) + V_F = 0$

$V_F = .7$ V for silicon diodes

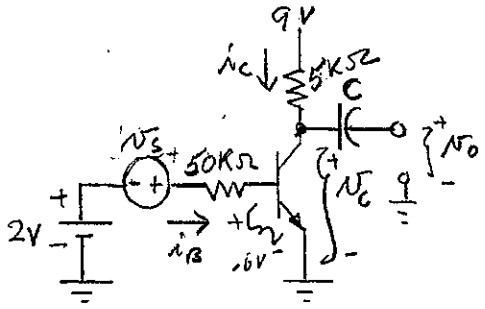
$I_{max} = (5.66 - 1.4)/200 = 21.3$ mA (.0213A)

KVL for reverse voltage:

$-5.66 + PIV + V_F = 0$

$PIV = 5.66 - .7 = 4.96$ V

2. (35) The β of the transistor below is 20. Find i_B, i_C, v_C, and v_o. Assume that the voltage drop between the base and emitter is 0.7 V.



KVL: $-2 - v_s + i_B 50K + .7 = 0$

$i_B = \frac{1.3 + v_s}{50K}$

$i_C = \beta i_B = 20\left(\frac{1.3+v_s}{50K}\right) = \frac{1.3+v_s}{2.5K}$

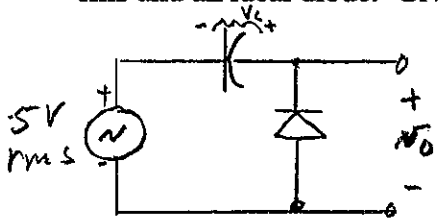
KVL: $-9 + 5K\, i_C + v_C = 0$

$v_C = 9 - 5K\left(\frac{1.3+v_s}{2.5K}\right) = 9 - 2.6 - 2v_s$

$v_C = 6.4 - 2v_s$

$v_o = -2v_s$ (the capacitor blocks the DC voltage)

3. (15) Sketch and label a clamping circuit. Describe how it works. Assume a sinusoidal source of 5 V rms and an ideal diode. Give the maximum and minimum values of the output voltage.



When the voltage source tries to make v_o negative, the diode turns on and charges the capacitor. Eventually, the capacitor voltage (V_C) reaches $5\sqrt{2} = 7.07$ V. From then on the diode remains off and $v_o = 7.07$ V + source voltage.

v_o max $= 2(7.07) = 14.14$ V.

v_o min $= 0$

4. (5) If an amplifier passes all frequencies between 10 kHz and 15 kHz, what is the approximate rise time of the amplifier?

$t_r \approx \frac{0.35}{BW} = \frac{0.35}{15{,}000 - 10{,}000} = 70\,\mu s$

5. (5) Most red LEDs have a forward voltage drop of about 2 V.