ENEE 307, Midterm Exam 2009

Part I (50pts.): The following questions refer to Figure 1. You can neglect the effects of g_m and r_π where appropriate. $\beta = 200$. $V_{in}(t) = (0.1)\sin(2\pi \times 10^4 t)$.

1. Find the small signal voltage gain (A_v).
2. Sketch voltage versus time at the emitter and at the output for one period. Label the axes and put in proper scales.
3. Now, suppose we can change the amplitude of the input signal. What is the largest amplitude of the input signal we can have before the output signal shows distortion. (Distortion is typically clipping.)

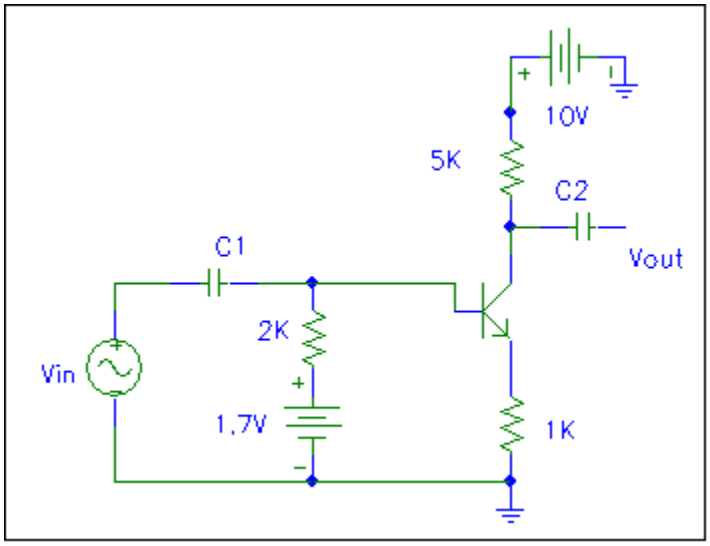


Figure 1

Part II (20pts.): The following questions refer to Figure 2. $V_{in}(t) = (10)\sin(2\pi \times 10^4 t)$.

1. Graph the voltage (V_A-V_B) across the resistor as a function of time for one period.
2. Describe in words the path of current through the circuit. Specify the times when each of the various diodes (D1, D2, D3, and D4) are on or off.

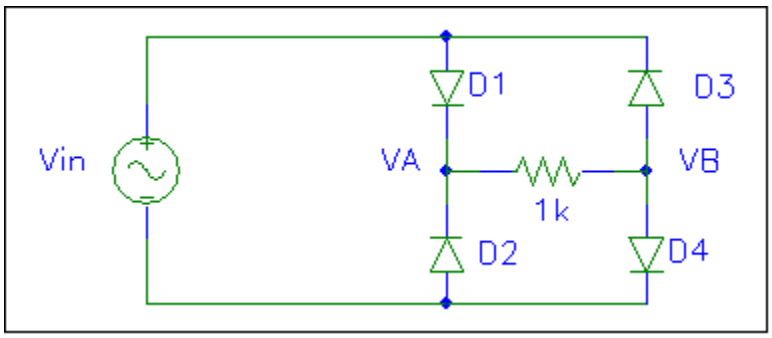


Figure 2

Part II (30pts.): The following questions refer to Figure 3. $V_{in}(t) = (10)\sin(2\pi \times 10^4 t)$. You can neglect the effects of g_m and r_π where appropriate, $\beta = 200$.

1. Derive an expression for the output voltage versus time for the voltage divider circuit in Figure 3a.
2. Derive an expression for the output voltage versus time for the push-pull circuit in Figure 3b.
3. Describe in words how the transistors work to make the output voltages different in figures 3a and 3b.

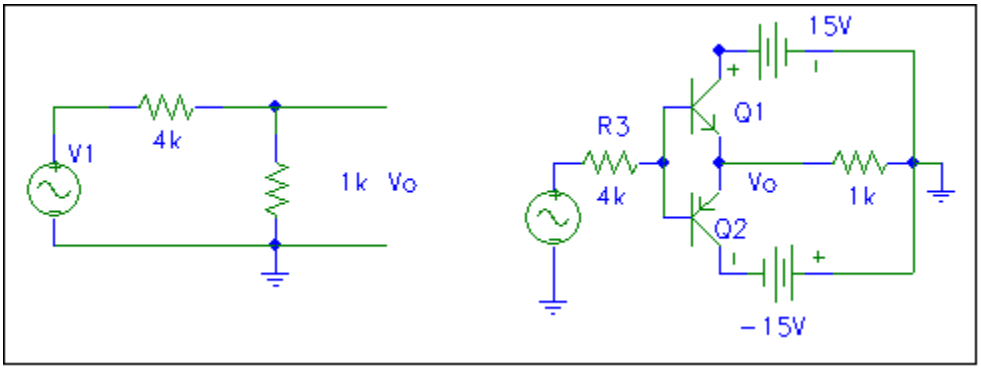


Figure 3a Figure 3b

$RTB = r_\pi + \beta RE$

$RTE = 1/g_m + RS/\beta$

RTC = infinity