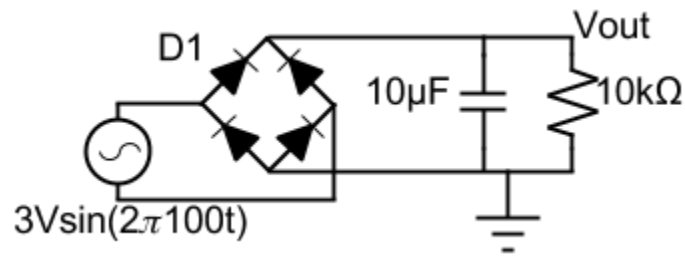


Lecture 3, Diodes  
E151/3 F17 – Matthew Spencer



1. The circuit above is called a full wave rectifier. When making sketches for this problem you may approximate the start of long exponentials as straight lines. You may also approximate the slope of sinusoids near the origin as linear. The diodes used are silicon diodes with  $V_{on}=0.7V$ .

(a) Sketch the voltage at  $V_{out}$ .

(b) Sketch the current in  $D1$ .

(c) Full wave rectifiers are often used as power supplies in energy harvesting circuits or when converting from mains power to a DC voltage. In such a use case, a load circuit would be attached between  $V_{out}$  and ground. You can approximate this load as a resistance, which is usually much smaller than  $10\text{ M}\Omega$ . Find a relationship between the value of the load resistance,  $R_l$  ( $\ll 10\text{ M}\Omega$ ), and the ripple that is observed in  $V_{out}$ . Instead of using  $100\text{ Hz}$  and  $10\mu\text{F}$  as the values in your analysis, use the variables  $C$  and  $f$ .

You may assume the ripple is small compared to the average value of  $V_{out}$ , which means that you may approximate the current through the resistor as constant and the phase offset caused by the droop in voltage as negligible.

2. What is the voltage change,  $V_d$ , applied across a diode which will result in the diode current ( $I_d$ ) changing by a factor of 10? Calculate this value for non-ideality factors of 1, 1.3, 1.5 and 2. You may assume the current passing through the diode is much larger than  $I_s$ .