EE40
Lecture 33
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11/28/07

Clamp Circuit

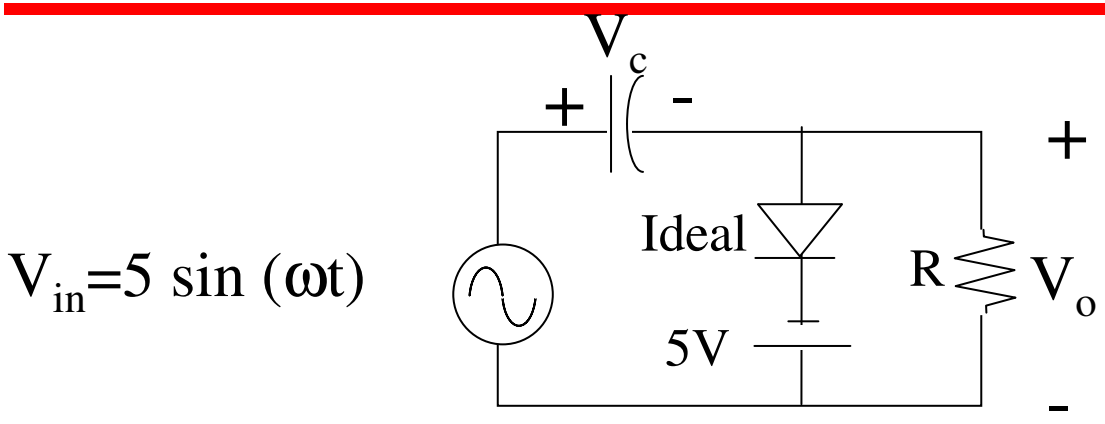
Clamp circuit

- It is a diode wave-shaping circuit
- It is used to add a DC component to an AC input wave forms so that
  - Either positive or negative peaks are clamped to not exceed a certain value.
- Consideration: capacitor is large so that
  - Under AC steady-state, capacitor voltage stays constant
- Do not worry about the first few cycles when you solve the clamp circuit – except for the level shifter (lecture notes 11/28-2).

Steps to solve clamp circuit:

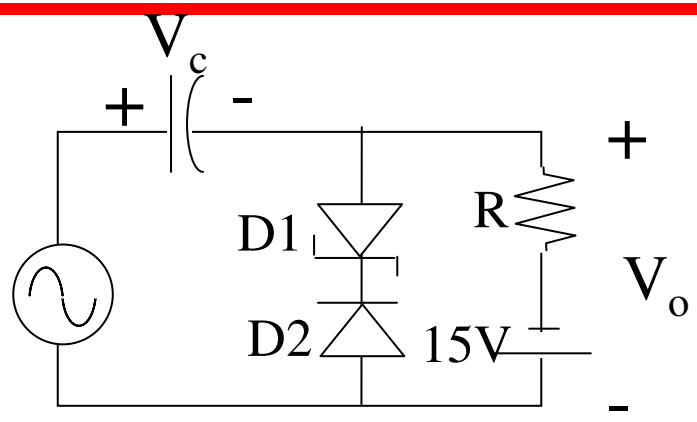
- Get the DC steady state value for V_0 for V_{in}=0
  - Under time variation, i.e. with $V_{in}=V_a \sin(wt)$, the min or max value of V_0 should be this value.
- Decide whether it is clamped at max or min side.
  - The camping happens when the diodes are ON, i.e. when there is current flow. This is to say when diode is forward-biased or Zener is reverse-biased at V_{BR}.

Example: Figure 10.33 (p 495)



1. Get the DC steady state value for V_0 for V_{in}=0
   1. This is when the capacitor is open circuit.
   2. In this case, the diode is ON and since it is an ideal diode, there is no voltage across it.
   3. V_o=-5V
   4. V_o=V_{in}- V_c; since V_{in}=0, V_c=5V
2. V_o =V_D-5; since V_D cannot be larger than 0, V_o cannot be larger than -5. This is the same as saying V_o < = -5
3. So in this case, V_o=5 sin (wt)-10

Example: Figure 10.34 (p 495)



$V_{in}=2 \sin(\omega t)$

D1: $V_{BR}=4.4$ V

D2: $V_{th}=0.6$ V

1. Get the DC steady state value for V_0 for $V_{in}=0$
   1. This is when the capacitor is open circuit.
   2. In this case, the diode D2 (and D1) has to be ON and a 15V is applied in forward bias condition and larger than 4.4+0.6=5V.
   3. $V_o=-(0.6+4.4)=-5$V
2. $V_o=-(V_{D2}-V_{D1})$; since V_{D2} cannot be larger than 0.6, V_{D1} cannot be smaller than 4.4, $V_{D2}-V_{D1}$ cannot be larger than 5. Hence, V_o cannot be smaller than -5. $V_o >= -5$
3. So in this case, $V_o=2 \sin(wt)-3$