Questions

1. For the circuit shown below in figure 1, you are given: $V_{DD} = 5V$ and $R = 1.67k\Omega$

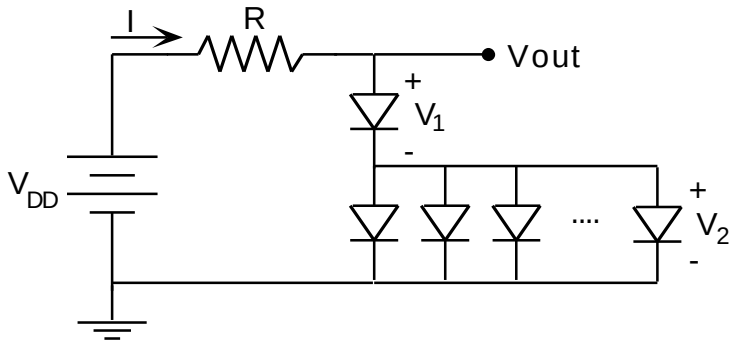


Figure 1

The number of diodes wired in parallel is M. All diodes in the circuit are identical, and have the following parameters: $I_S = 10^{-15} A$ and $n = 1.25$. Use the exponential model for each diode.

Find the magnitudes of I, V_1, V_2 and the number of diodes that need to be wired in parallel (i.e. find M) such that the output voltage is 1.657 V.

2. For the circuit shown below in figure 2, use the constant-voltage-drop model.

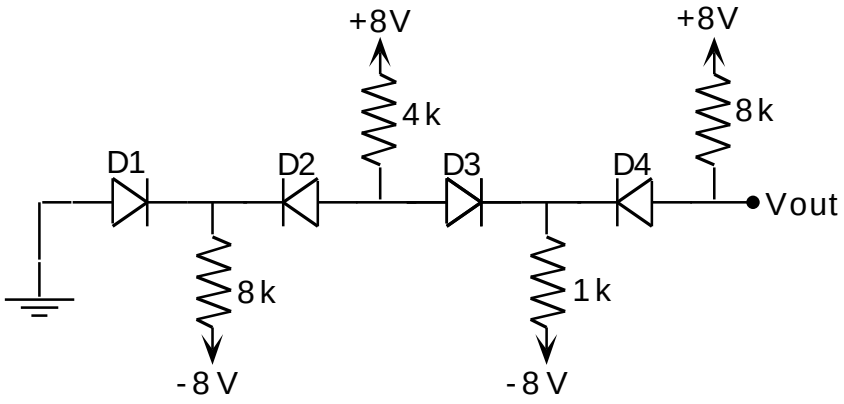
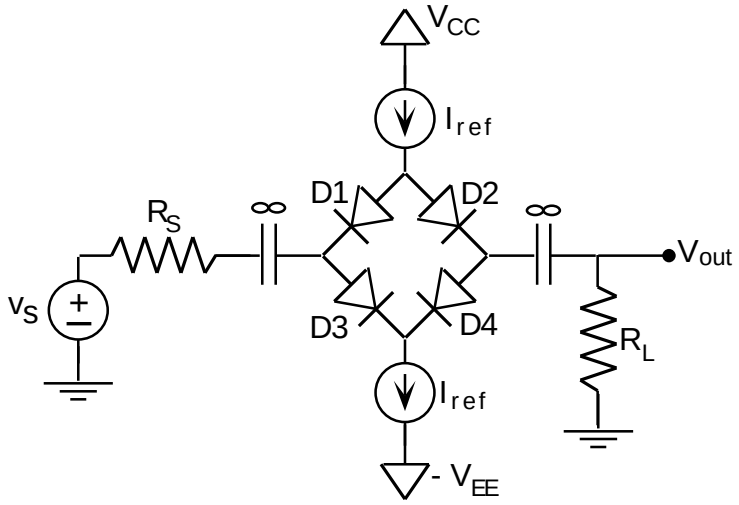


Figure 2

Determine V_{out}, and the current flowing through each diode. Clearly state all of your assumptions, and justify them.

Hint: D1 and D4 are both ON.

3. Consider the circuit below. **All diodes are identical**. The two capacitors (infinite capacitance) are used to couple the input signal source to the diode circuit, and to couple the output of the diode circuit to the load resistor. They have no effect on signal analysis, but completely block DC current.

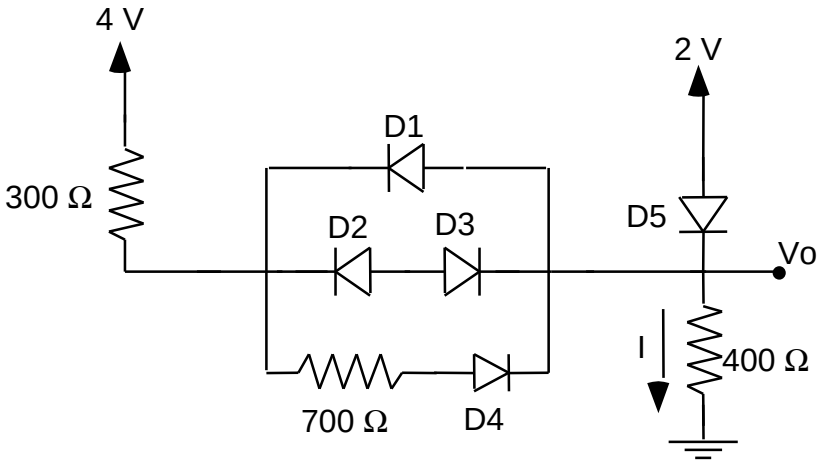


a) Draw the equivalent circuit for purposes of DC analysis.

b) **For each diode**, find expressions for the current flowing through it, and the small-signal diode resistance.

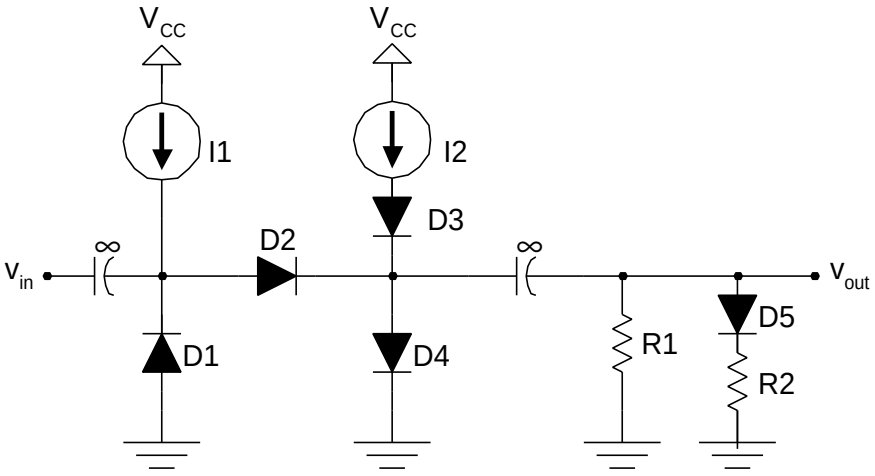
c) Draw the small-signal equivalent circuit, and determine an expression for the voltage gain v_{out}/v_s.

4. Analyze the diode circuit shown below using the **constant voltage drop model**



Determine:
a) which diodes are ON
b) the current I
c) the current through the 300 ? resistor

5. Given the following circuit:

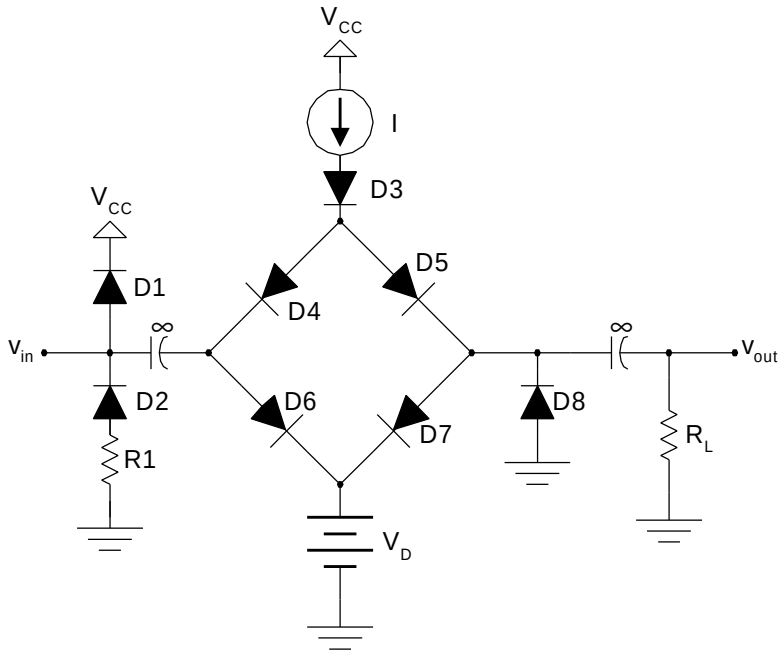


Where: $I1 = 0.25mA$, $I2 = 0.75mA$, $R1 = 1k\Omega$, and $R2 = 500\Omega$

<u>note</u>: all diodes are identical with n = 1

a) Determine the DC current through each diode.
b) Draw the equivalent circuit for small-signal analysis.
c) Determine the voltage gain v_{out}/v_{in}.

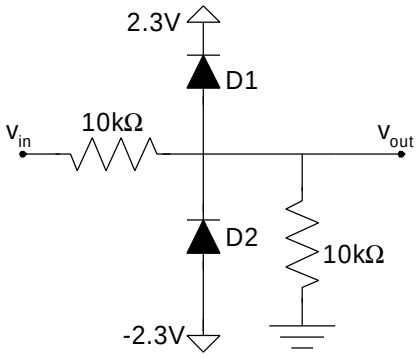
6. Repeat problem 5 for the circuit below:



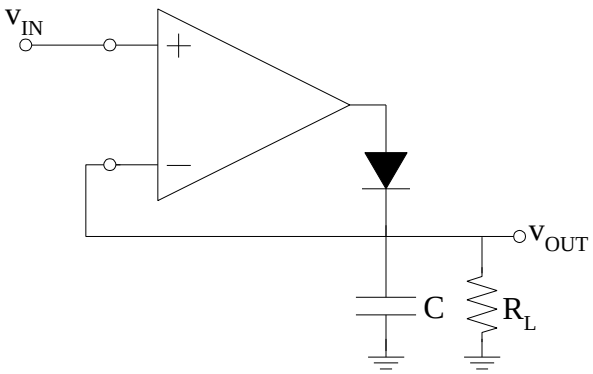
Where: $V_{CC} = 10V$, $I = 0.5mA$, $R_1 = 200\Omega$, $R_L = 500\Omega$, and $V_D = -0.5V$

<u>note</u>: all diodes are identical with n = 1

7. The circuit shown below is a limiting circuit. Sketch its voltage transfer characteristic using the constant voltage drop model for the diodes.



8. The clamping circuit shown below performs peak detection, and is similar to the circuit on slide 3.53, except that the diode is replaced by a “superdiode”.



Assuming the constant voltage drop model for the diode, derive an expression for v_{OUT} in terms of v_{IN}. Assume the open-loop gain of the op-amp is finite (A).

9. For the rectifier circuit shown on slide 3.81, derive an expression for the slope of the non-horizontal portion of the voltage transfer characteristic.

10. For the circuit shown below, derive an expression for the input resistance seen by the signal source v_S.