Last Lecture → Exponential Model

DC Analysis
- Ideal Model
- Constant-Voltage-Drop Model
- Exponential Model
  - Graphical Analysis
  - Numerical Analysis

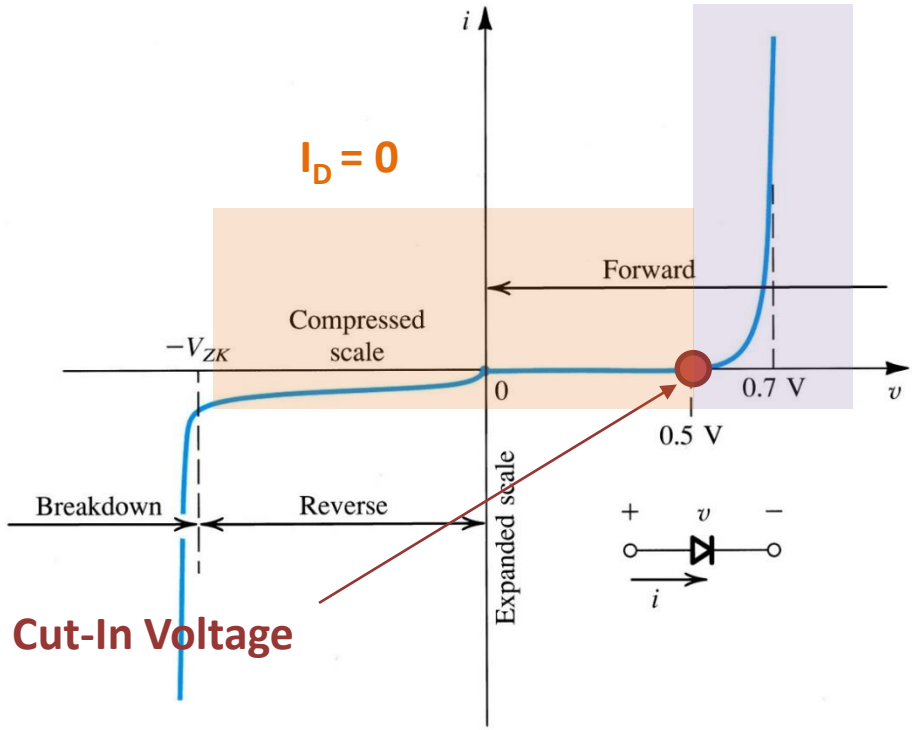
AC Analysis
- Small Signal Model

Problem Solving

1) assume the status of all diodes

2) solve via mesh / nodal analysis

3) check for coherence



Exponential Model

$$for\ v < 0.5 \rightarrow I_D \approx 0$$

$$for\ v > 0.5 \rightarrow I_D \approx I_S e^{v_D/V_T}$$

Last Lecture → Ideall Model

DC Analysis
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  - Graphical Analysis
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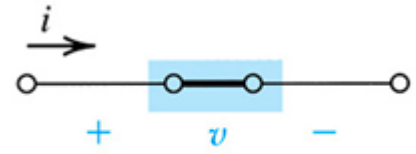
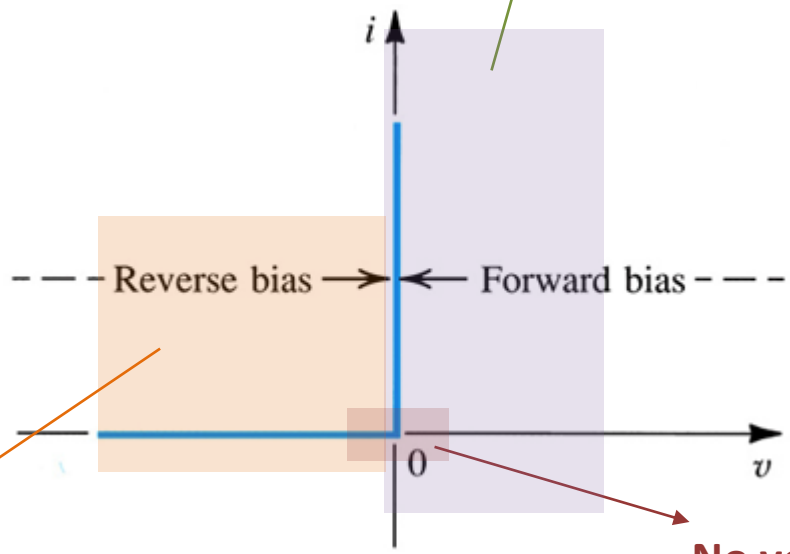
AC Analysis
- Small Signal Model

I_D is not a function of V_D



$i > 0 \Rightarrow v = 0$



No reverse current

No voltage drop when conducting current

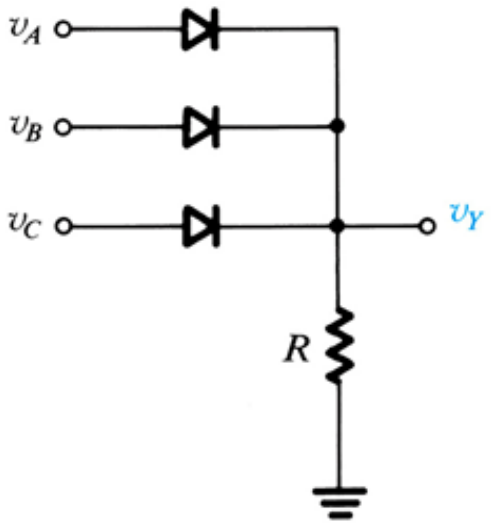
Ideal Model

$for\ v < 0 \rightarrow I_D = 0$

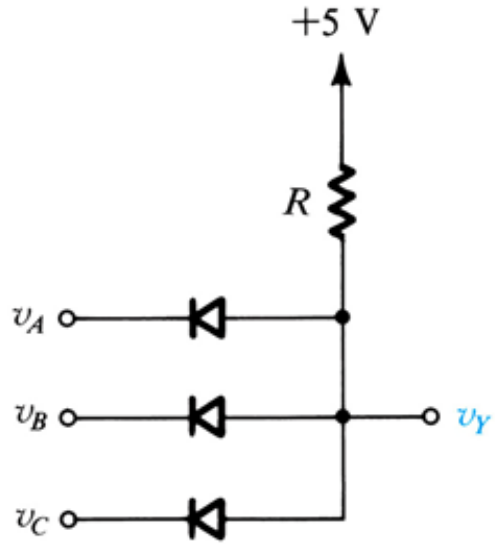
$for\ ID > 0 \rightarrow v = 0$

Diode Logic Gates

Diodes together with resistors can be used to implement logic functions…



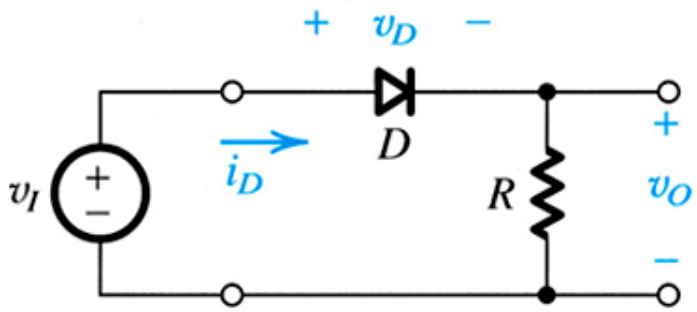
(a)

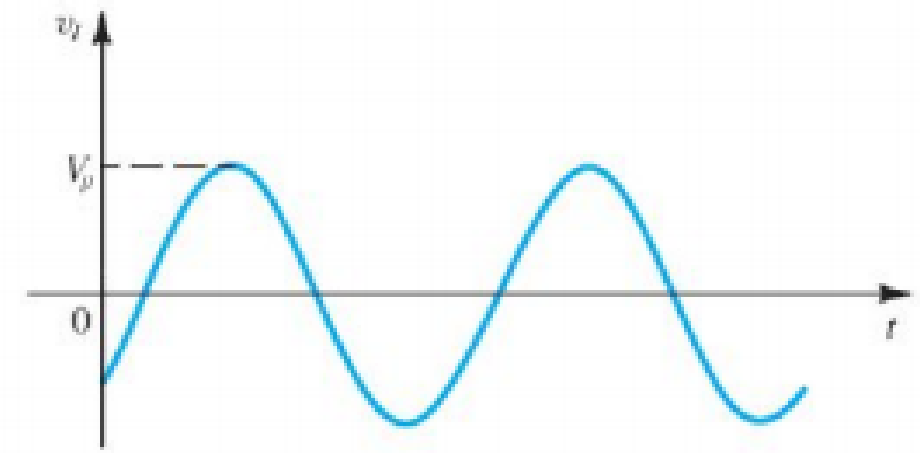


(b)

A Simple Application

→ The Rectifier

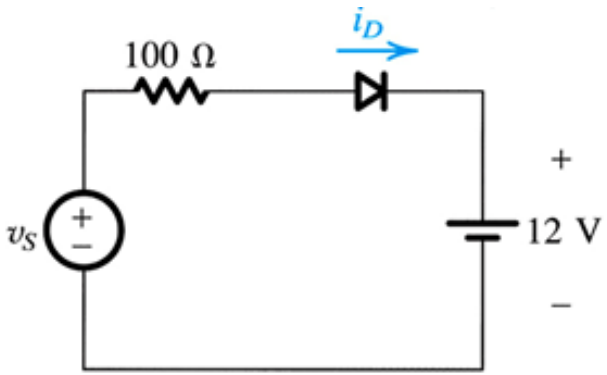


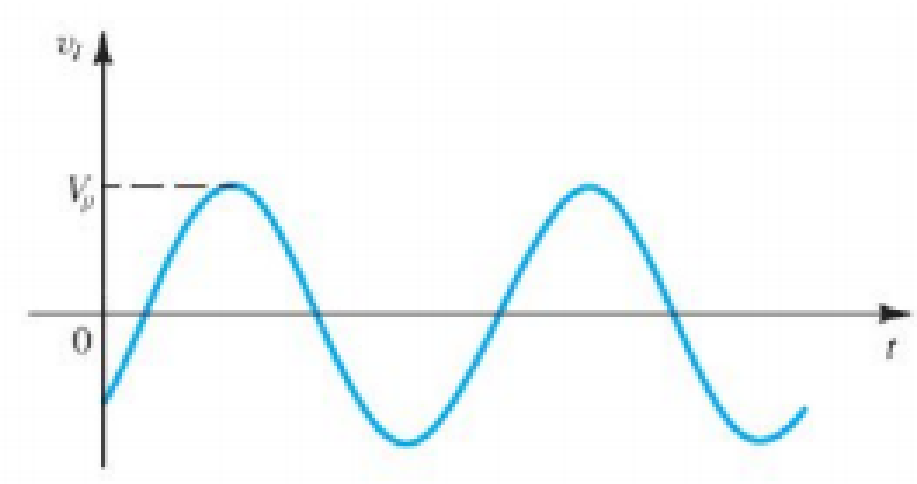


Example 4.1

For the following circuit, assuming v_s is a sinusoid with 24-V peak amplitude find

a) **the fraction of each cycle during which the diode conducts**
b) **the peak value of the diode current**
c) **The maximum reverse-bias voltage that appears across the diode**

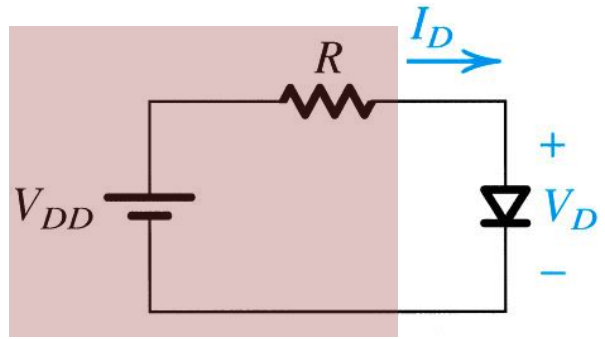


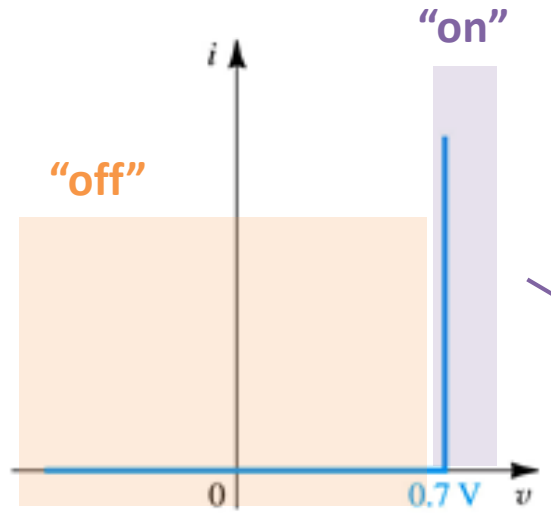


Constant-Voltage-Drop Model

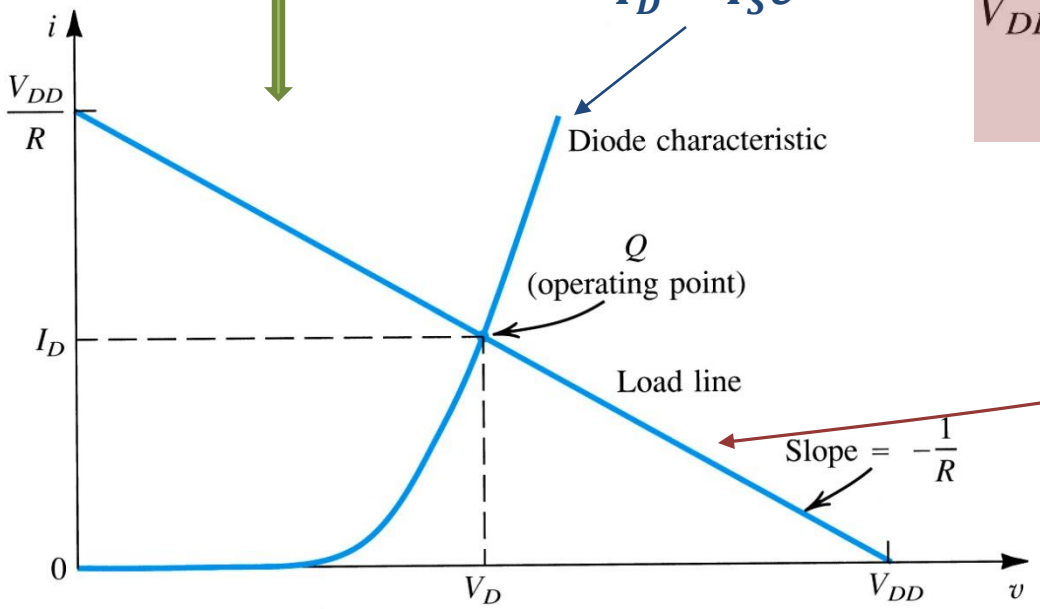
DC Analysis

- ✓ Ideal Model
- • Constant-Voltage-Drop Model
- ✓ Exponential Model
  - • Graphical Analysis
  - ✓ Numerical Analysis

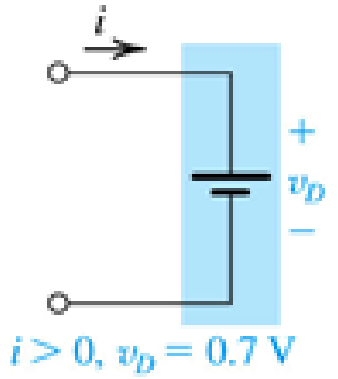




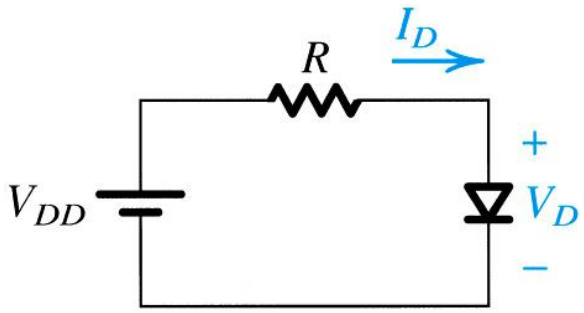
$I_D \approx I_S e^{v/V_T}$



- If diode is "on"
  → $v_d = 0.7V$
  ∴ $I_d > 0$
- If diode is "off"
  → $I_d = 0V$
  ∴ $v_d < 0.7V$



Diode Models → Comparison



For the given circuit determine I_d using all three models of the diodes. Assume

- ***V_{DD} = 5V***
- ***R = 1kOhm***

- ***V_D = 0.7V (constant voltage model)***
- ***I_{D_Q} = 1mA @ 0.7V (exponential model)***

Model	I_d (mA)
Ideal	5.00
Constant Voltage Drop	4.30
Exponential	4.26