كلية مدينة العلم الجامعة

قسم هندسة الحاسوب

محاضرات المرحلة الاولى لمادة الهندسة الالكترونية

اعداد

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المحاضرة الرابعة

Solved Problems اسئلة محلولة

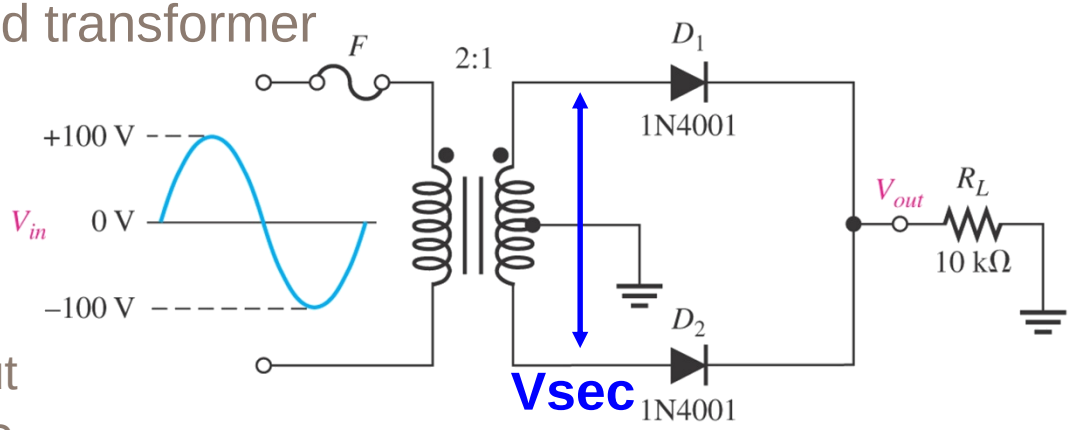
Electronic Devices and Circuit Theory

Eleventh Edition

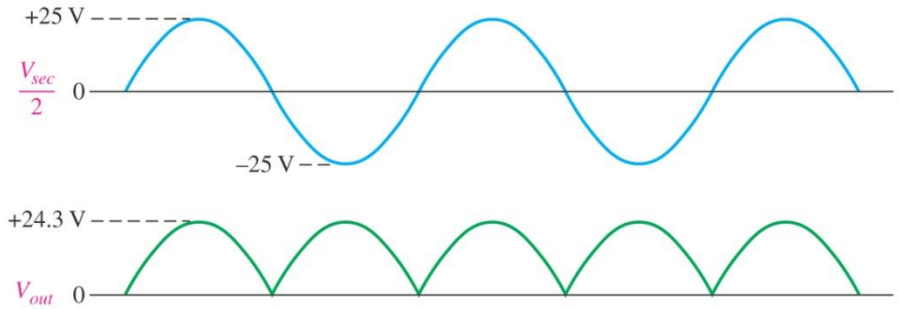
Robert L. Boylestad and Louis Nashelsky

Full-wave Rectifier - Example

- Assuming a center-tapped transformer
  - Find the turns ratio
  - Find Vsec
  - Find Vout
  - Find PIV
  - Draw the Vsec and Vout
  - What is the output freq?

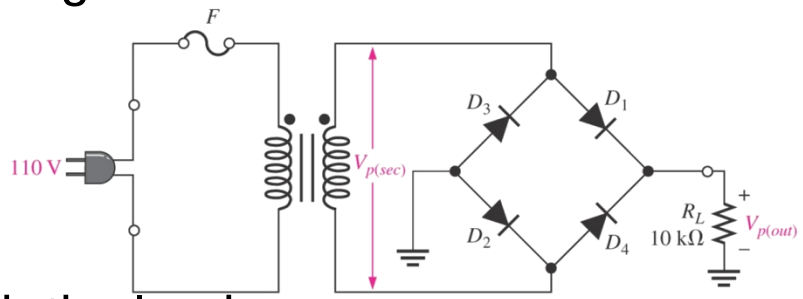


- n=1:2=0.5
- Vsec=n*Vpri=25
- Vout = Vsec/2 – 0.7
- PIV = Vsec-0.7=24.3 V



Bridge Full-wave Rectifier

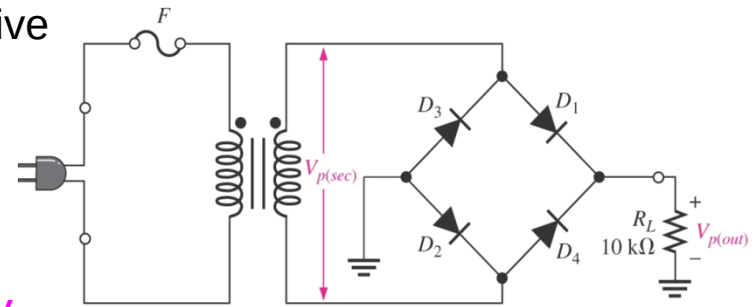
- Uses an untapped transformer → larger Vsec
- Four diodes connected creating a bridge
  - When positive voltage →
    - D1 and D2 are forward biased
  - When negative voltage →
    - D3 and D4 are forward biased



- Two diodes are always in series with the load
  - Vp(out) = Vp(sec) – 1.4V
  - The negative voltage is inverted
- The Peak Inverse Voltage (PIV)
  - PIV=Vp(out)+0.7

Bridge Full-wave Rectifier - Example

- Assume 12 Vrms secondary voltage for the standard 120 Vrms across the primary
  - Find the turns ratio
  - Find Vp(sec)
  - Show the signal direction when Vin is positive
  - Find PIV rating



n=Vsec/Vpri = 0.1→10:1

Vp(sec) = $(0.707)^{-1}$ x Vrms = 1.414(12)=17 V

Vp(out) = V(sec) – (0.7 + 0.7) = 15.6 V through D1&D2

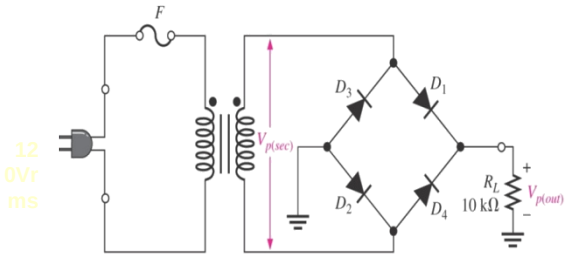
PIV = Vp(out) + 0.7 = 16.3 **V**

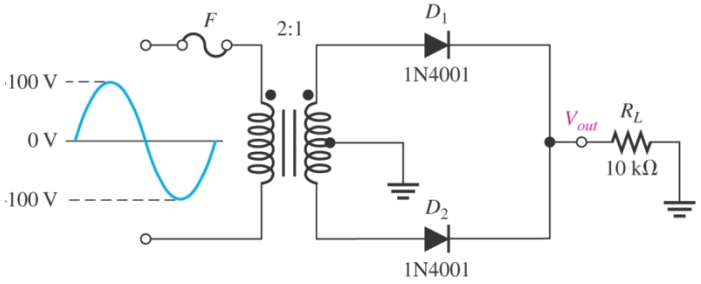
Note: Vp-Vbr ; hence, always convert from rms to Vp

Bridge Full-wave Rectifier - Comparison

	Half-wave	Full-wave	Bridge
Number of diodes	1	2	4
Rectifier input	$V_{p(2)}$	$0.5V_{p(2)}$	$V_{p(2)}$
DC output (ideal)	$V_{p(2)}$	$0.5V_{p(2)}$	$V_{p(2)}$
DC output (2d)	$V_{p(2)} - 0.7$ V	$0.5V_{p(2)} - 0.7$ V	$V_{p(2)} - 1.4$ V
Ripple frequency	f_{in}	$2f_{in}$	$2f_{in}$
PIV	$2V_{p(2)}$	$V_{p(2)}$	$V_{p(2)}$
Diode current	I_{dc}	$0.5I_{dc}$	$0.5I_{dc}$

Vp(2)=Peak secondary voltage ; Vp(out) Peak output voltage ; Idc = dc load current

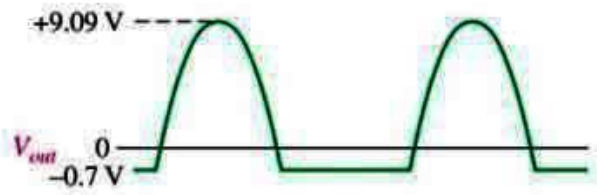




Make sure you understand this!

Diode clipper

- What is Vout?
  - $Vout^{+} = Vin\ (R_L)/(R_L+R_1) = 9.09$
  - $Vout^{-} = -0.7$

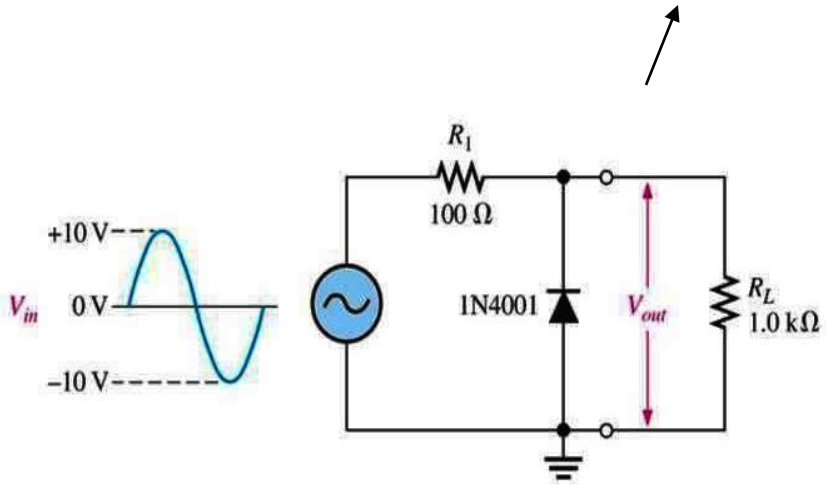


Forward biased when positive

Reverse biased when negative,

hence voltage drop is only -0.7

So how can we change the offset?



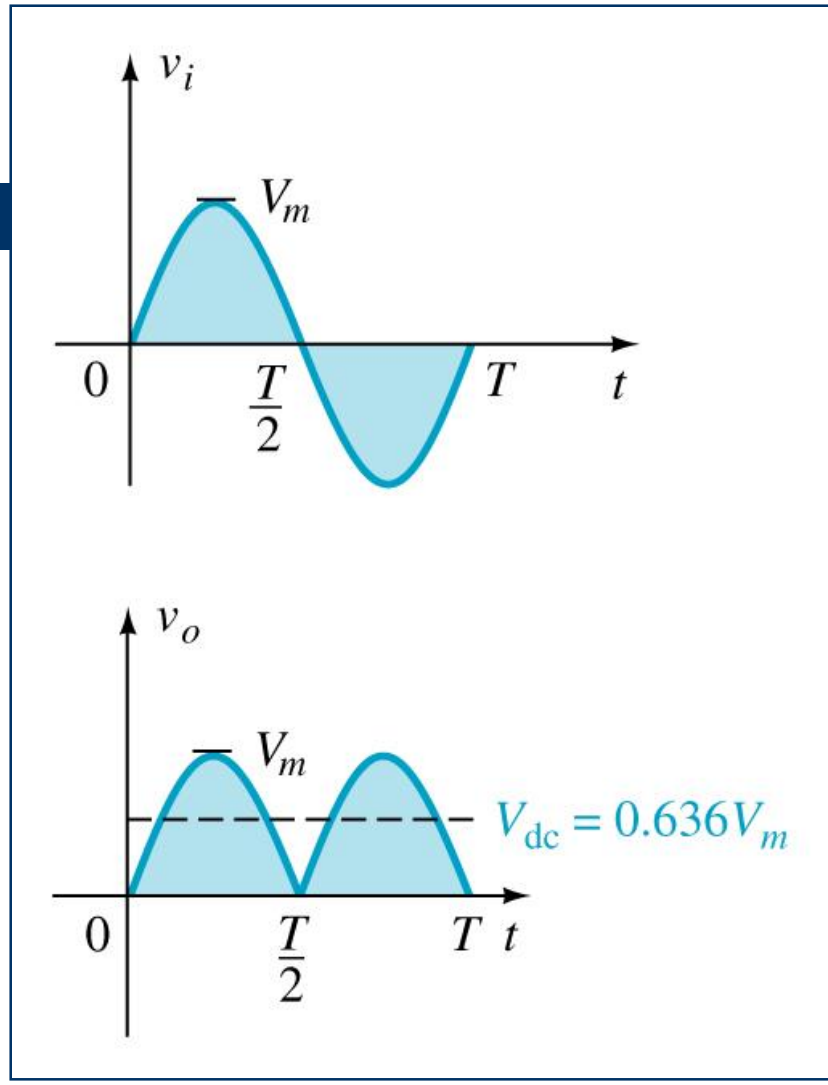
Full-Wave Rectification

The rectification process can be improved by using a full-wave rectifier circuit.

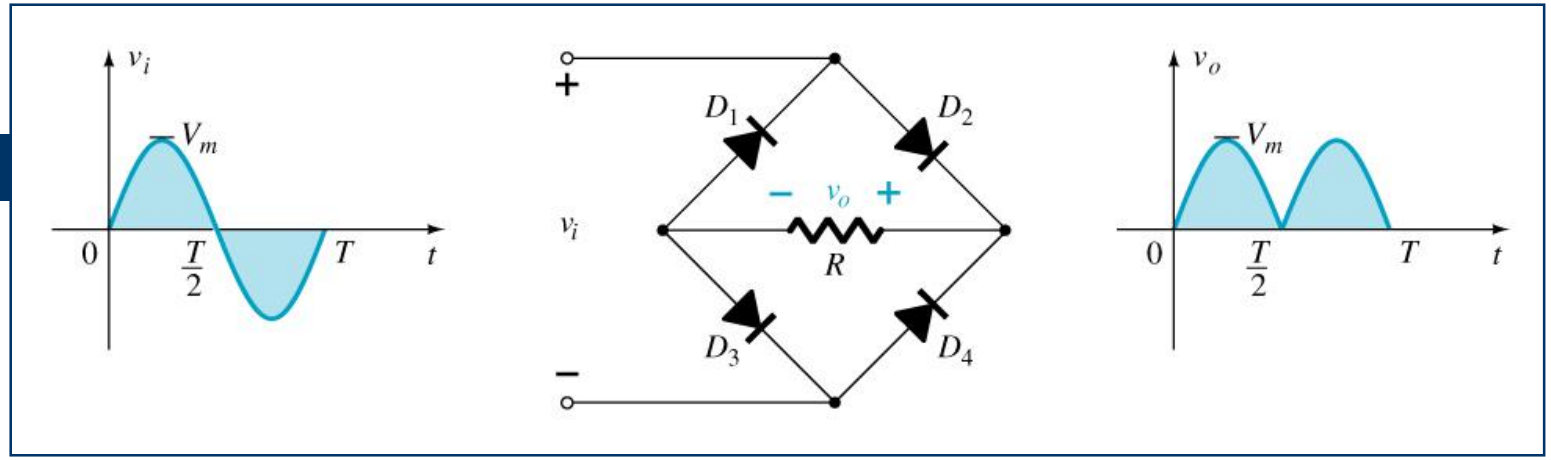
Full-wave rectification produces a greater DC output:

Half-wave: $V_{dc} = 0.318\,V_m$

Full-wave: $V_{dc} = 0.636\,V_m$



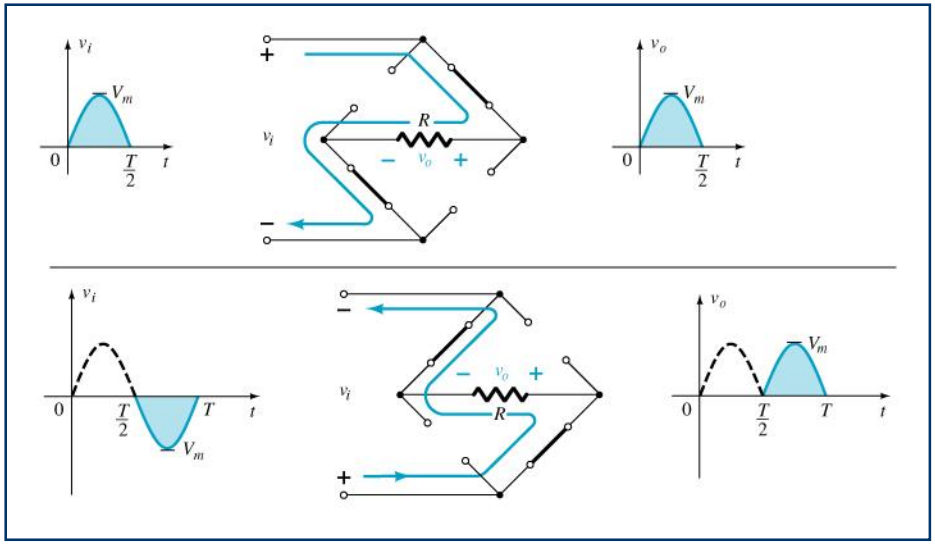
Full-Wave Rectification



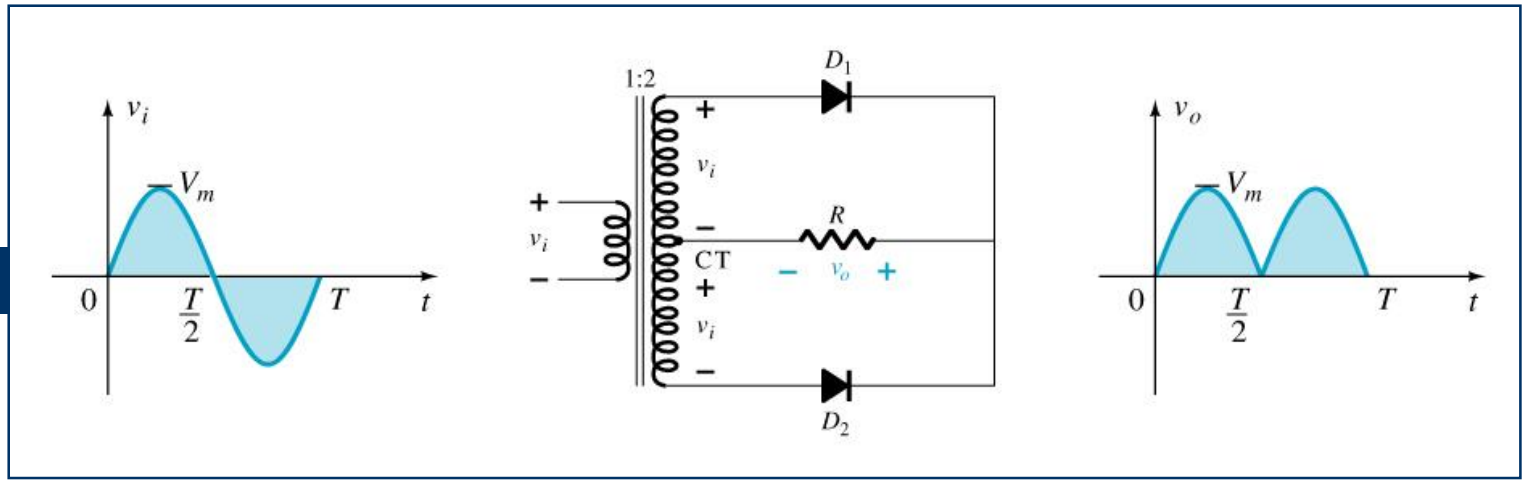
Bridge Rectifier

A full-wave rectifier with four diodes that are connected in a bridge configuration

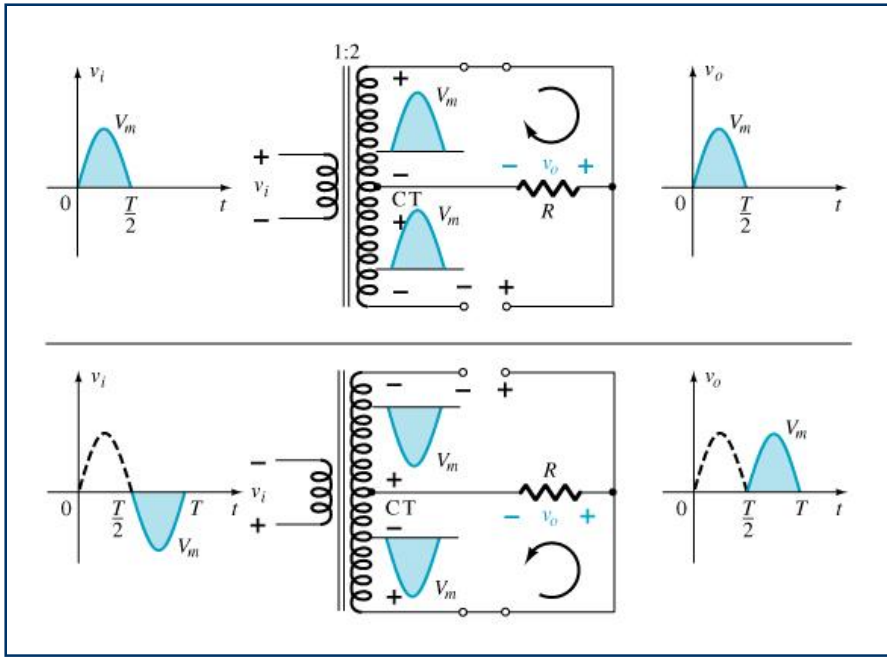
$$V_{DC} = 0.636\,V_m$$



Full-Wave Rectification



Center-Tapped Transformer Rectifier



Requires two diodes and a center-tapped transformer

$$V_{DC} = 0.636\,V_m$$

Summary of Rectifier Circuits

In the center tapped transformer rectifier circuit, the peak AC voltage is the transformer secondary voltage to the tap.

Rectifier	Ideal V_{DC}	Realistic V_{DC}
Half Wave Rectifier	$V_{DC} = 0.318\,V_m$	$V_{DC} = 0.318\,V_m - 0.7$
Bridge Rectifier	$V_{DC} = 0.636\,V_m$	$V_{DC} = 0.636\,V_m - 2(0.7\text{ V})$
Center-Tapped Transformer Rectifier	$V_{DC} = 0.636\,V_m$	$V_{DC} = 0.636\,V_m - 0.7\text{ V}$

V_m = the peak AC voltage