Lecture 5

DIODE PRACTICAL APPLICATIONS

AC Rectification تقويم التيار المتناوب

DR. BASSAM ATIEH

MANARA UNIVERSITY

تقويم التيار المتناوب AC Rectification

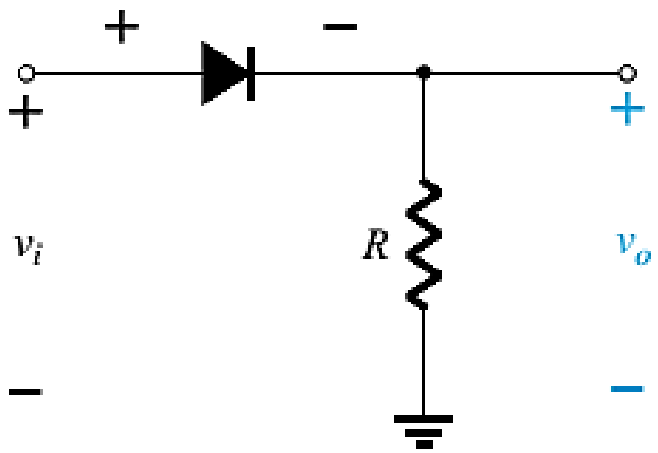
التقويم هو عملية تحويل الإشارات (جهود أو تيارات) المتغيرة مع الزمن إلى إشارات مستمرة القيمة وغير متعلقة بالزمن.

- Half-Wave Rectification
- Full-Wave Rectification

Bridge Rectifier

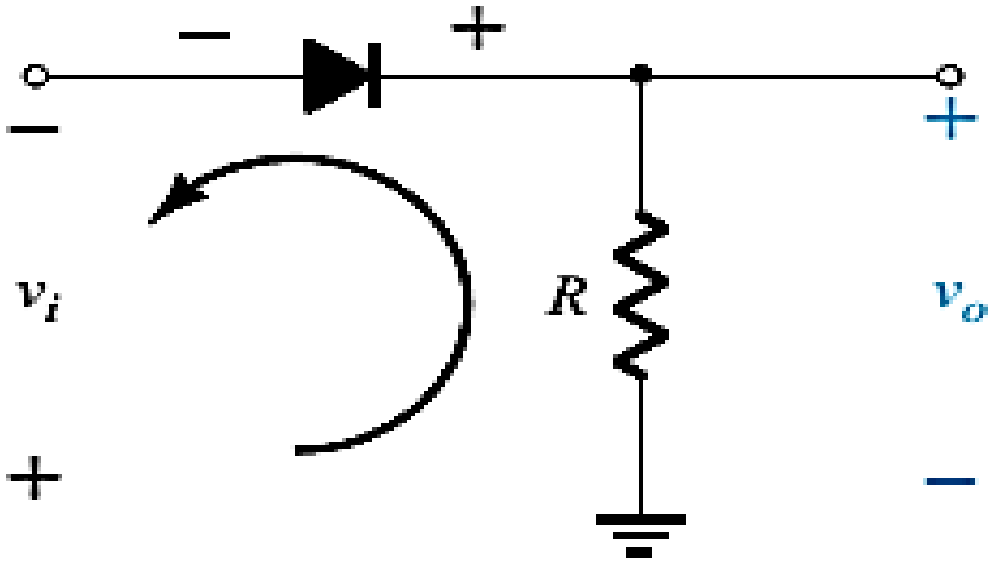
Center-Tapped Transformer

تقويم التيار المتناوب AC Rectification

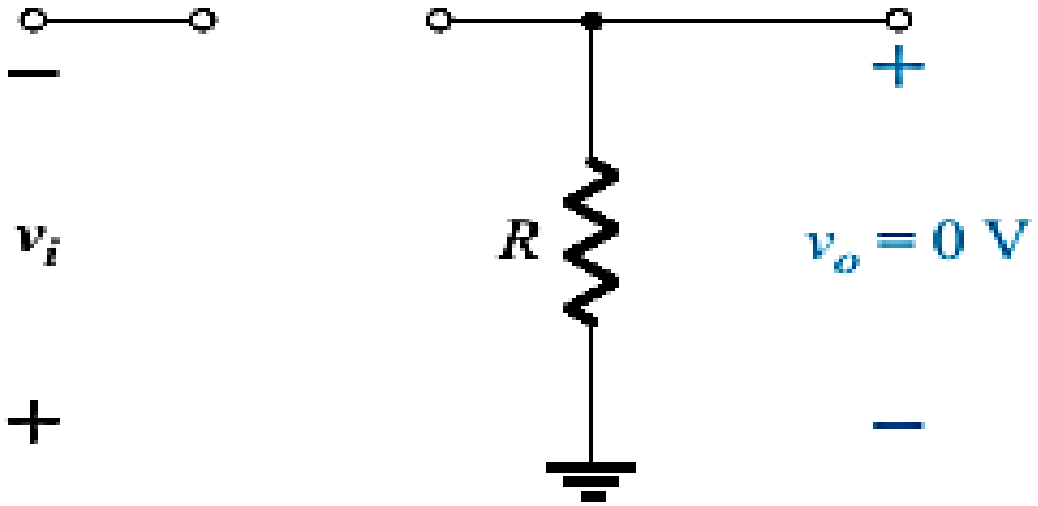


التقويم هو عملية تحويل الإشارات (جهود أو تيارات) المتغيرة مع الـــزمن إلـــى إشـــارات مستمرة القيمة وغير متعلقة بالزمن.

تقويم نصف الموجة: Half – wave Rectification



الدارة المكافئة في حالة الانحياز الامامي

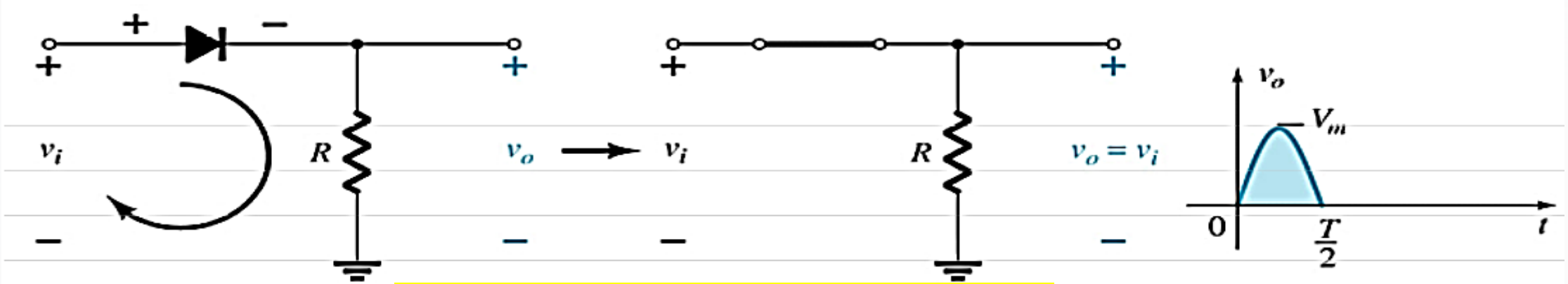


الدارة المكافئة في حالة الانحياز العكسي

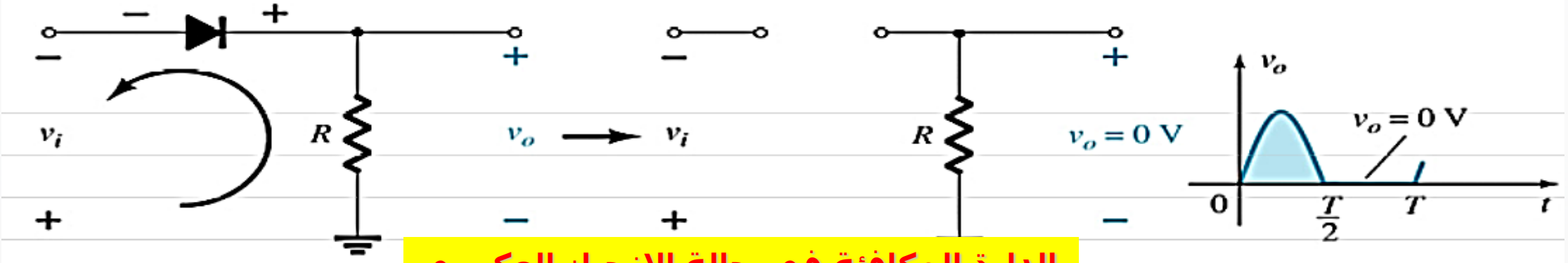
Half-Wave Rectification

Half – wave Rectification :تقويم نصف الموجة

The diode only conducts when it is forward biased, therefore only half of the AC cycle passes through the diode to the output.



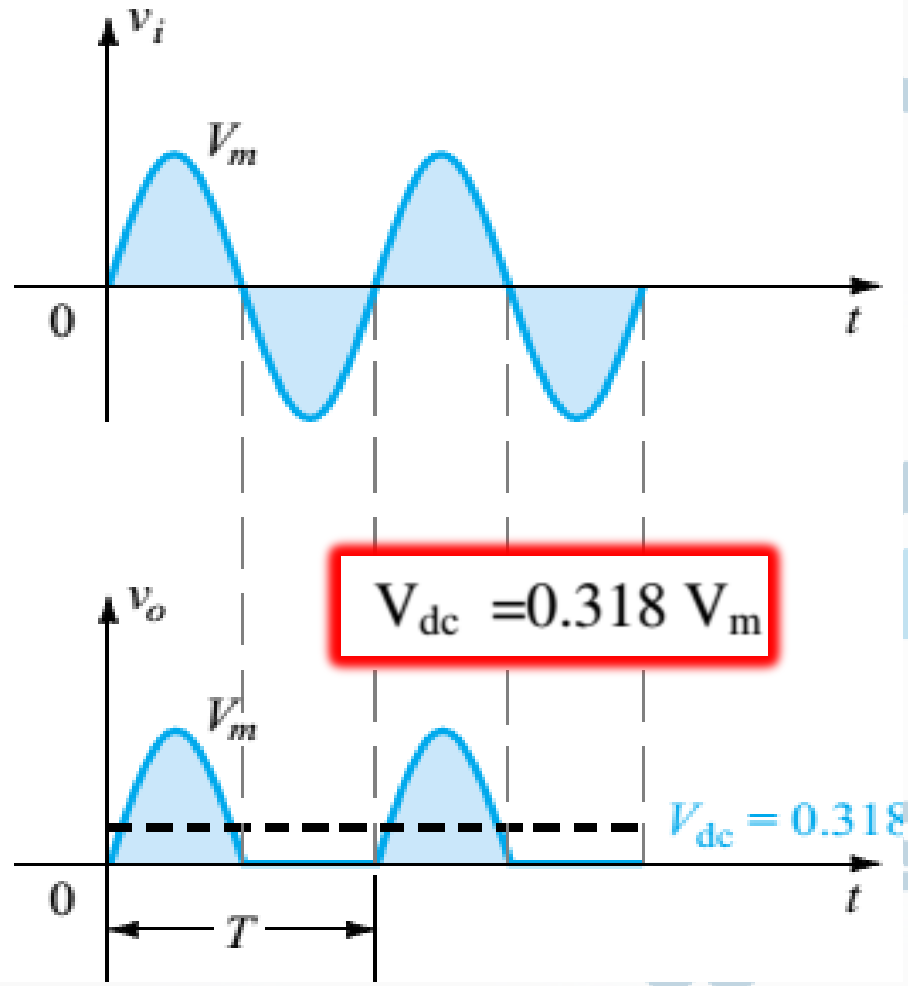
الدارة المكافئة في حالة الانحياز الامامي



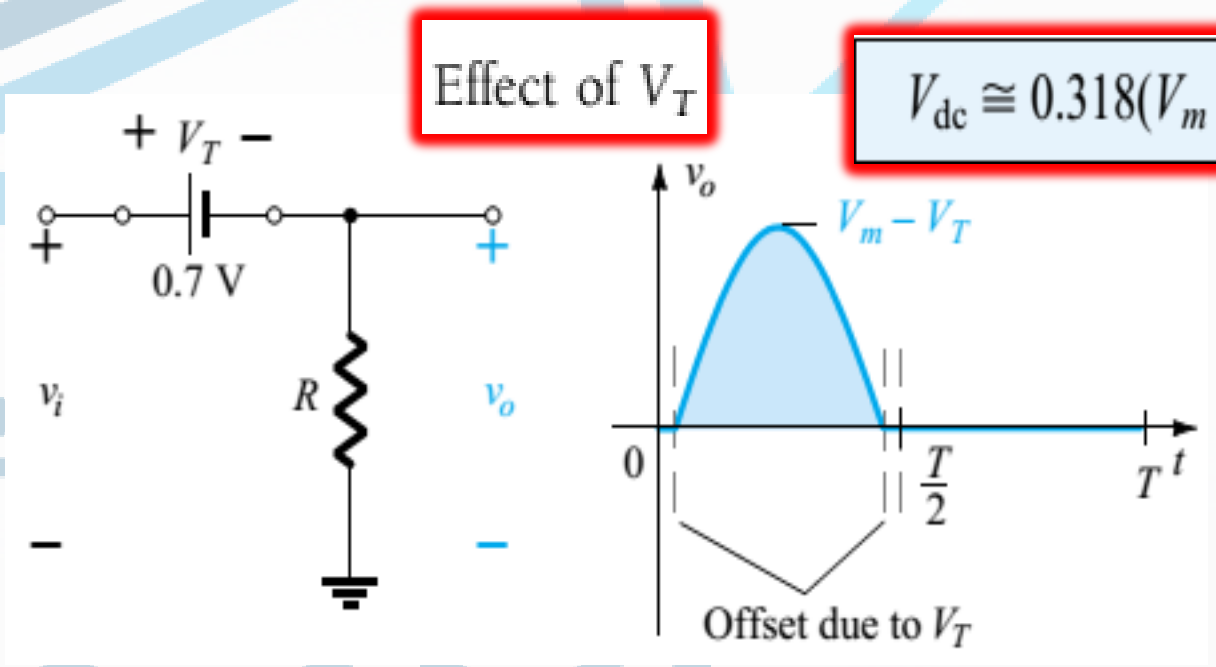
الدارة المكافئة في حالة الانحياز العكسي

The DC output voltage is 0.318 V_m, where V_m = the peak AC voltage.

استنتاج اشارة جهد الخرج لدارة تقويم نصف موجة



$V_{dc} = 0.318\ V_m$



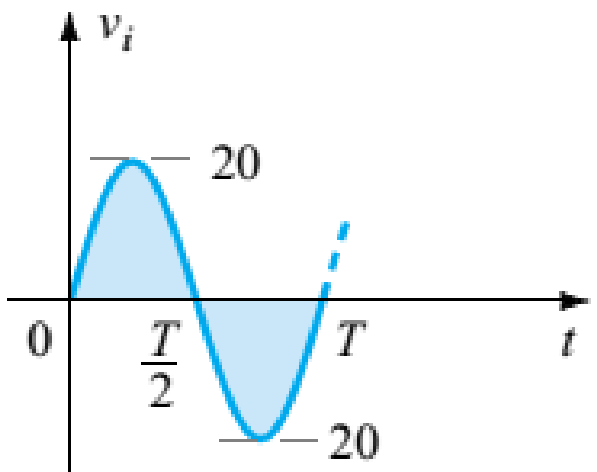
$V_{dc} \cong 0.318(V_m - V_T)$

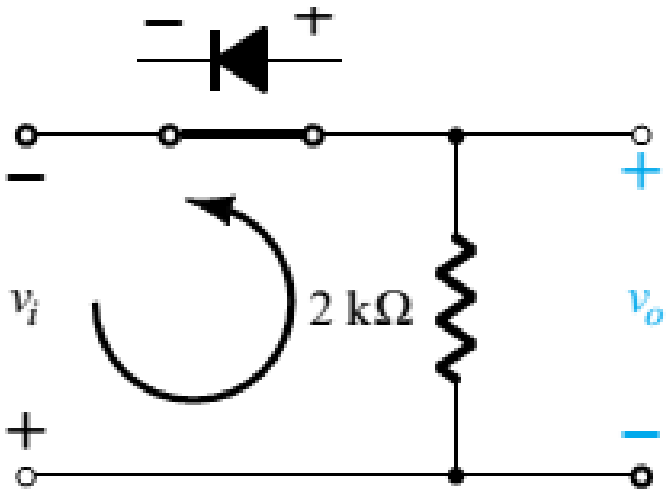
شكل اشارة جهد الخرج وقيمتها المتوسطة لدارة تقويم نصف موجة لحالة الديود المثالي

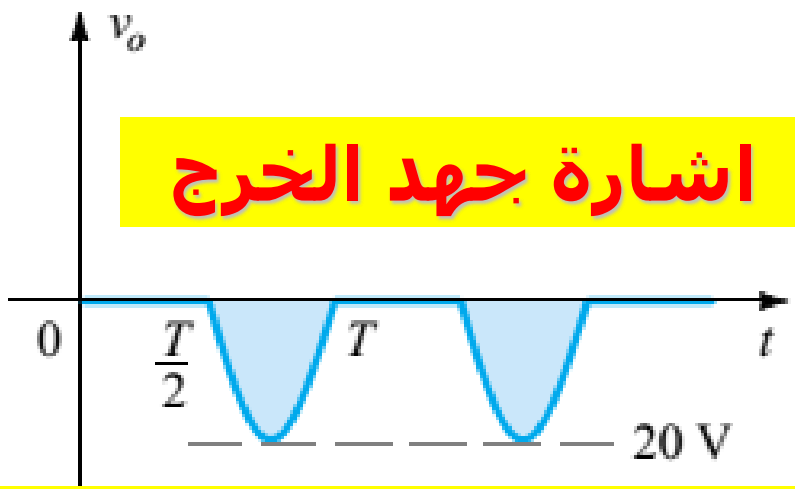
شكل اشارة جهد الخرج وقيمتها المتوسطة لدارة تقويم نصف موجة لحالة الديود العملي

استنتاج اشارة جهد الخرج لدارة تقويم نصف موجة سالبة

اشارة جهد الدخل







اشارة جهد الخرج

if V_m is increased to 200 V

القيم المتوسطة لإشارة جهد الخرج لدارة تقويم نصف موجة سالبة

$$V_{dc} = -0.318V_m = -0.318(200\text{ V}) = \mathbf{-63.6\ V}$$

$$V_{dc} = -0.318(V_m - V_T) = -0.318(200\text{ V} - 0.7\text{ V})$$
$$= -(0.318)(199.3\text{ V}) = \mathbf{-63.38\ V}$$

تحديد الجهد العكسي الاعظمي للديود

PIV (PRV)

peak inverse voltage (PIV) [or PRV (peak reverse voltage)]

$$\text{PIV rating} \geqq V_m$$ half-wave rectifier

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PIV (PRV)

Because the diode is only forward biased for one-half of the AC cycle, it is also reverse biased for one-half cycle.

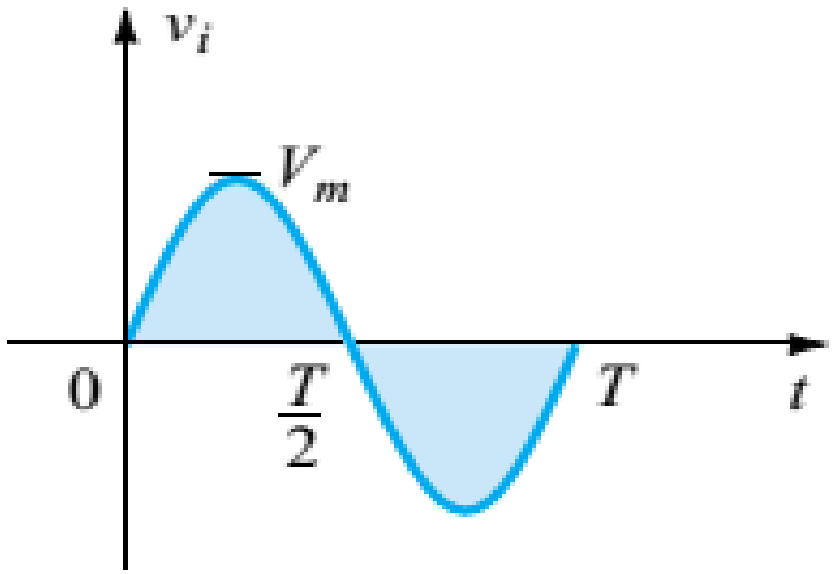
It is important that the reverse breakdown voltage rating of the diode be high enough to withstand the peak, reverse-biasing AC voltage.

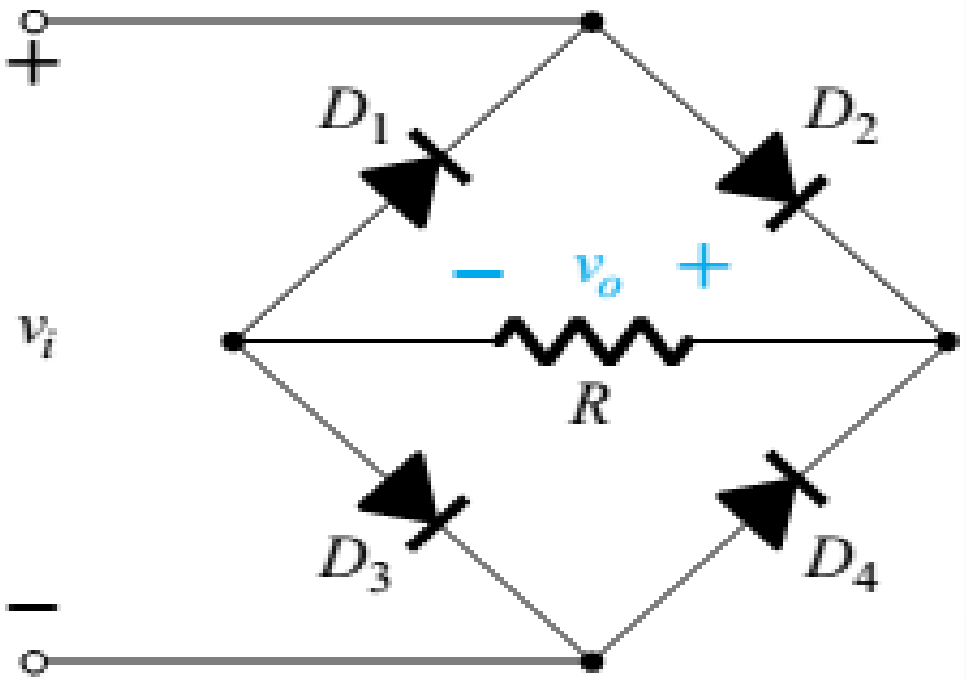
PIV (or PRV) > V_m

- PIV = Peak inverse voltage
- PRV = Peak reverse voltage
- V_m = Peak AC voltage

Full – Wave Rectification

تقويم الموجة الكاملة.



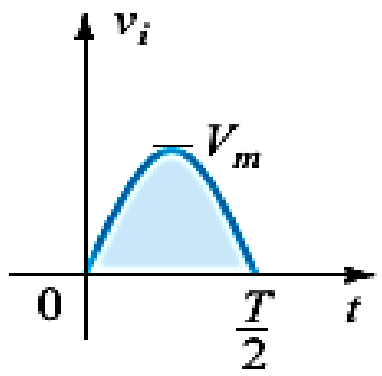


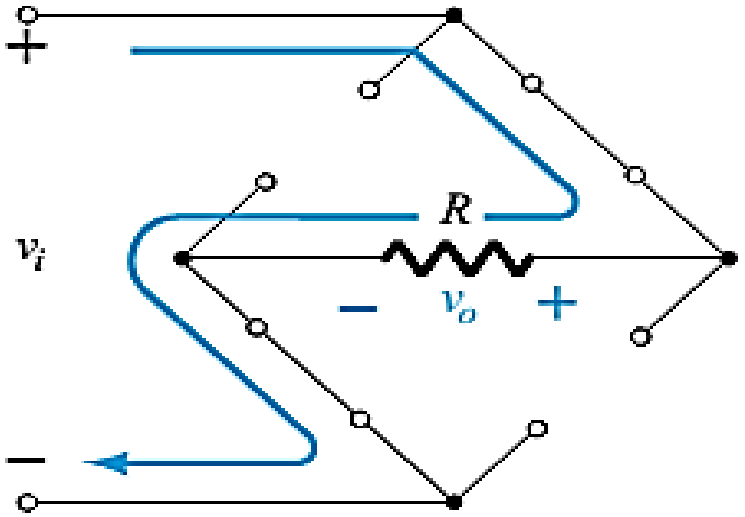
اشارة جهد الدخل

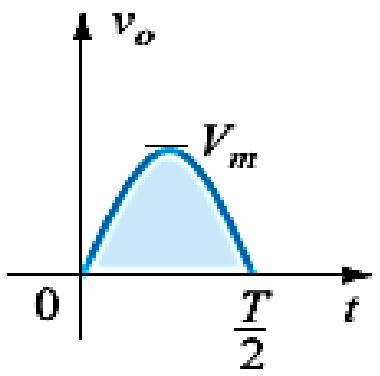
دارة التقويم الجسرية

تحليل عمل دارة التقويم الجسرية

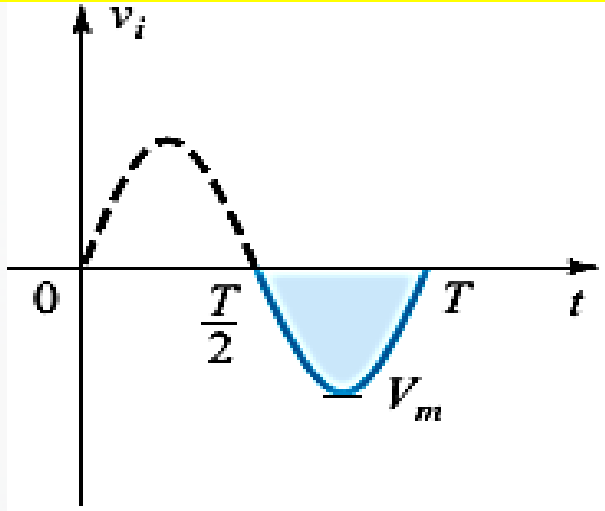
خلال نصف الموجة الاول

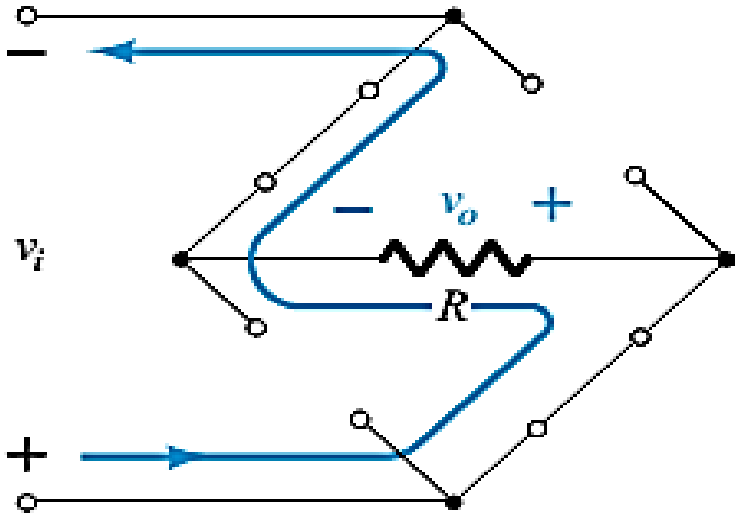




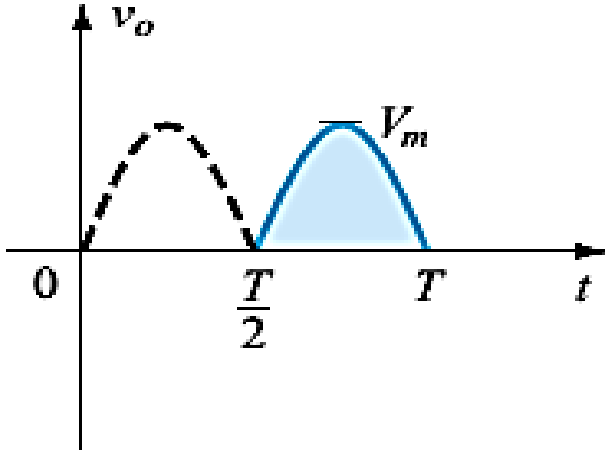


خلال نصف الموجة الثاني

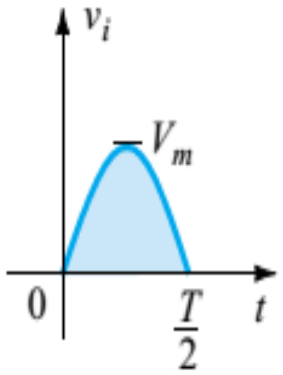


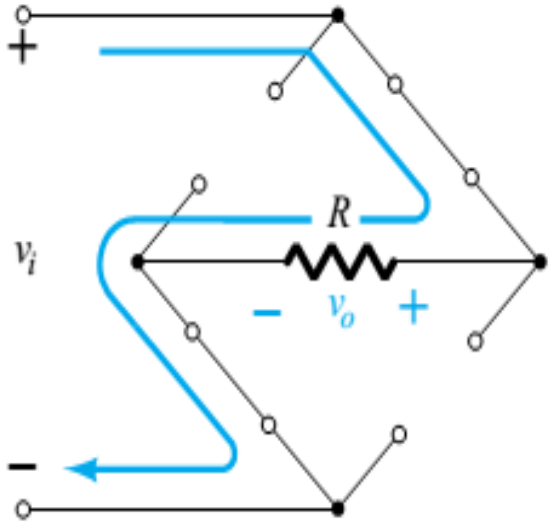


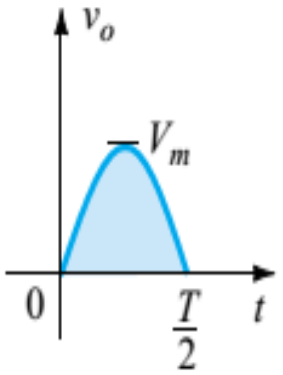
اشارة الخرج

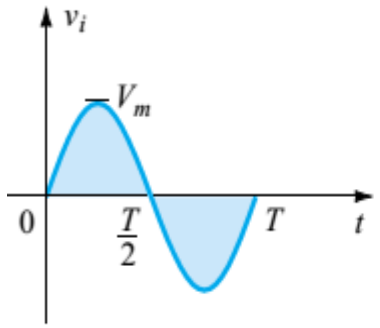


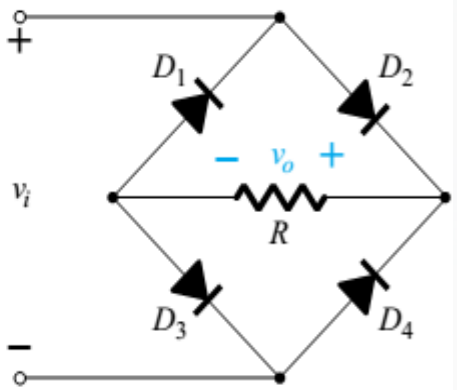
Full – Wave Rectification

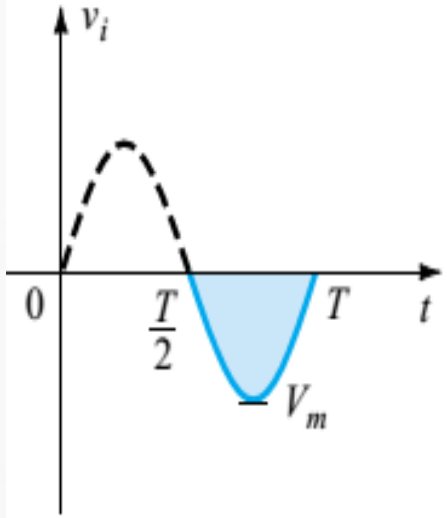


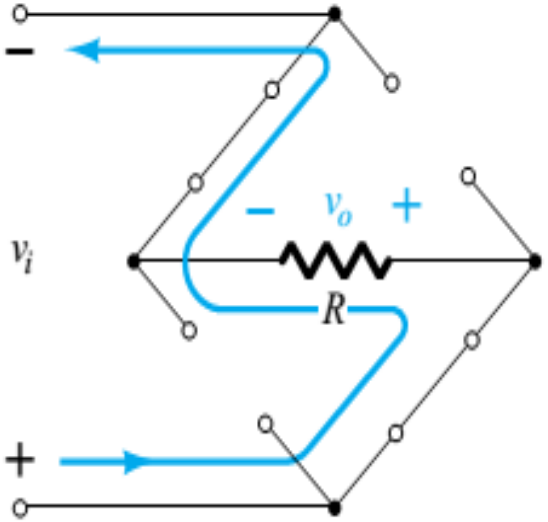


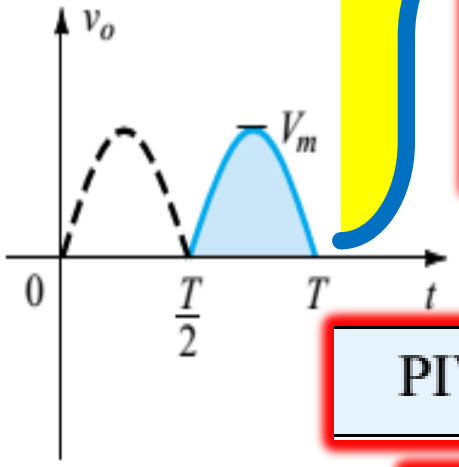


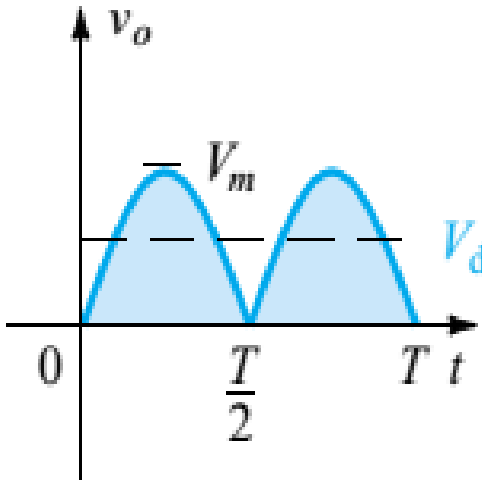






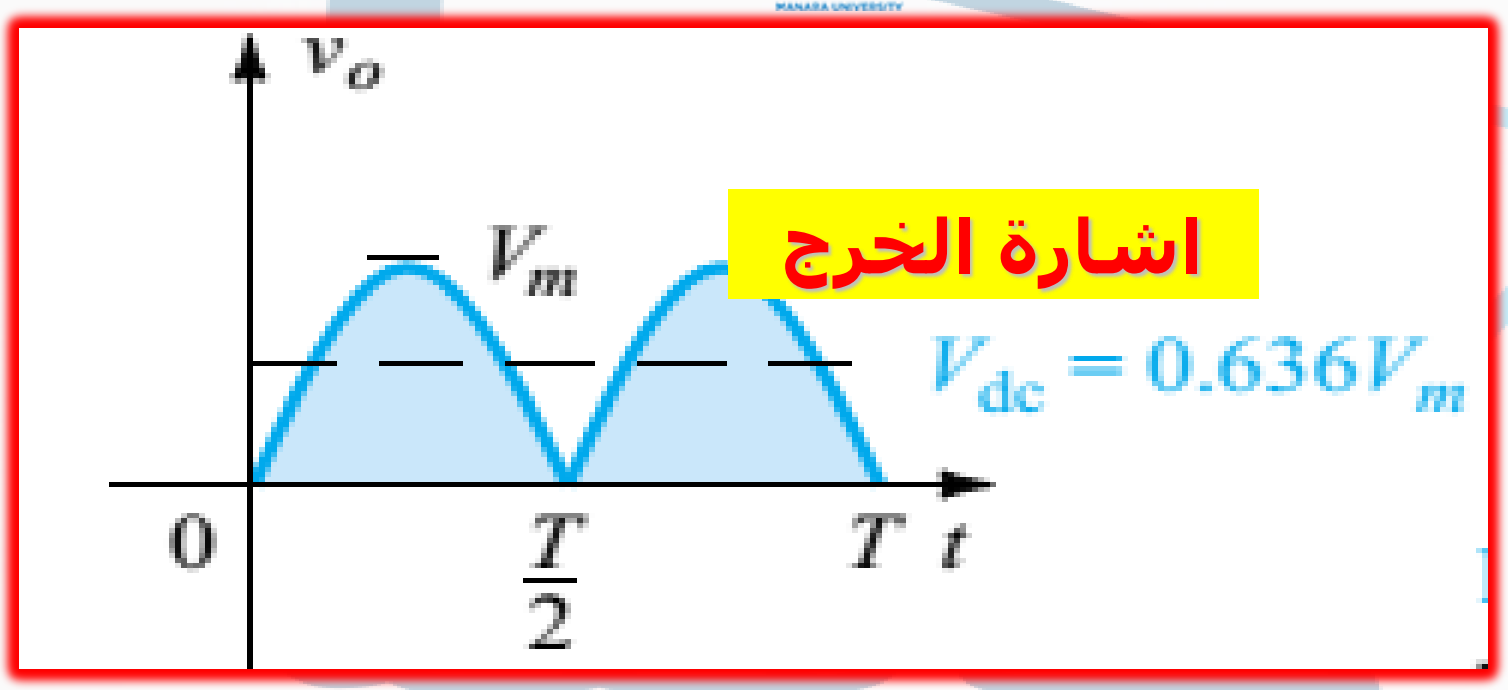






PIV $\geqq V_m$	full-wave bridge rectifier

$$V_{dc} \cong 0.636(V_m - 2V_T)$$



$$V_{dc} \cong 0.636(V_m - 2V_T)$$

القيمة المتوسطة لإشارة جهد الخرج لدارة تقويم موجة كاملة

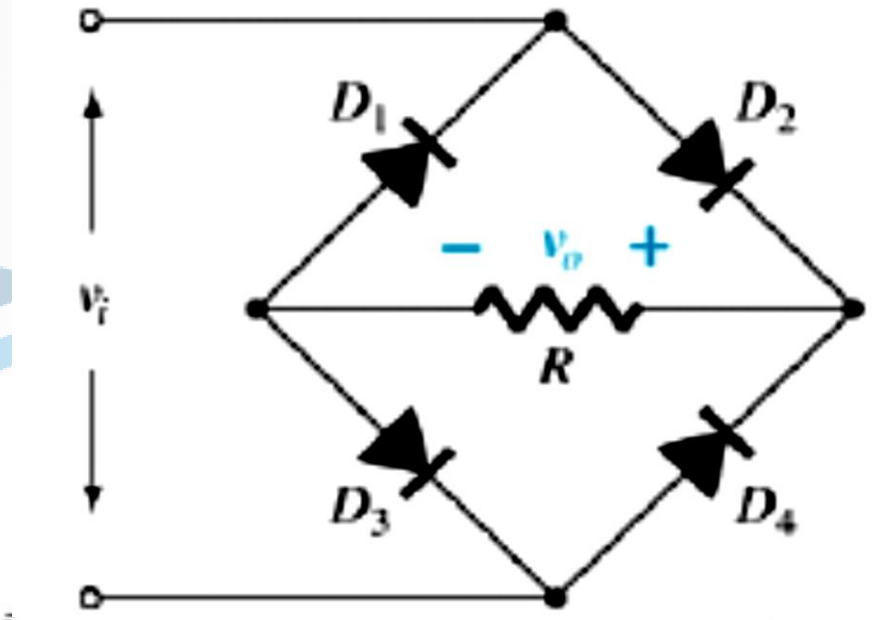
$$\text{PIV} \geqq V_m$$

full-wave bridge rectifier

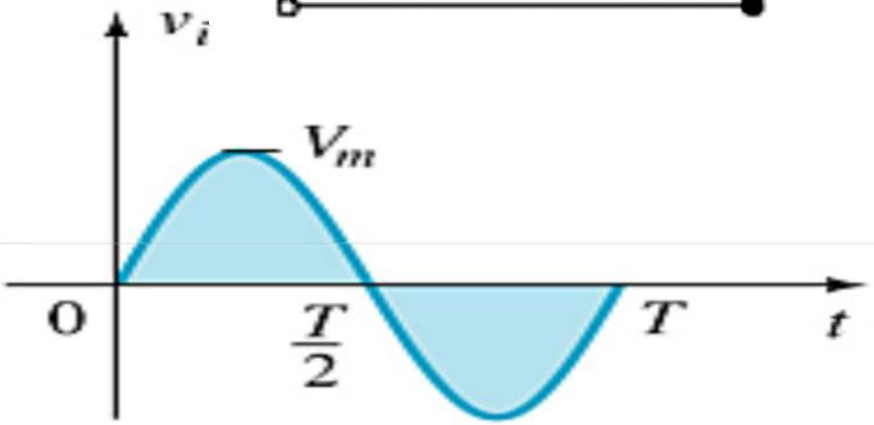
الجهد العكسي الاعظمي للديود

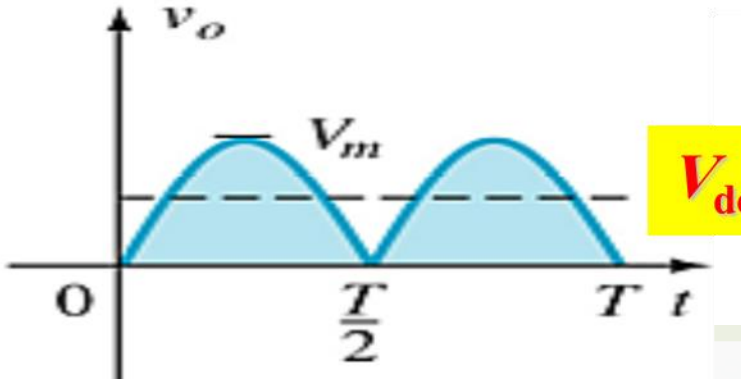
Full-Wave Rectification

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



Full-wave rectification produces a greater DC output:



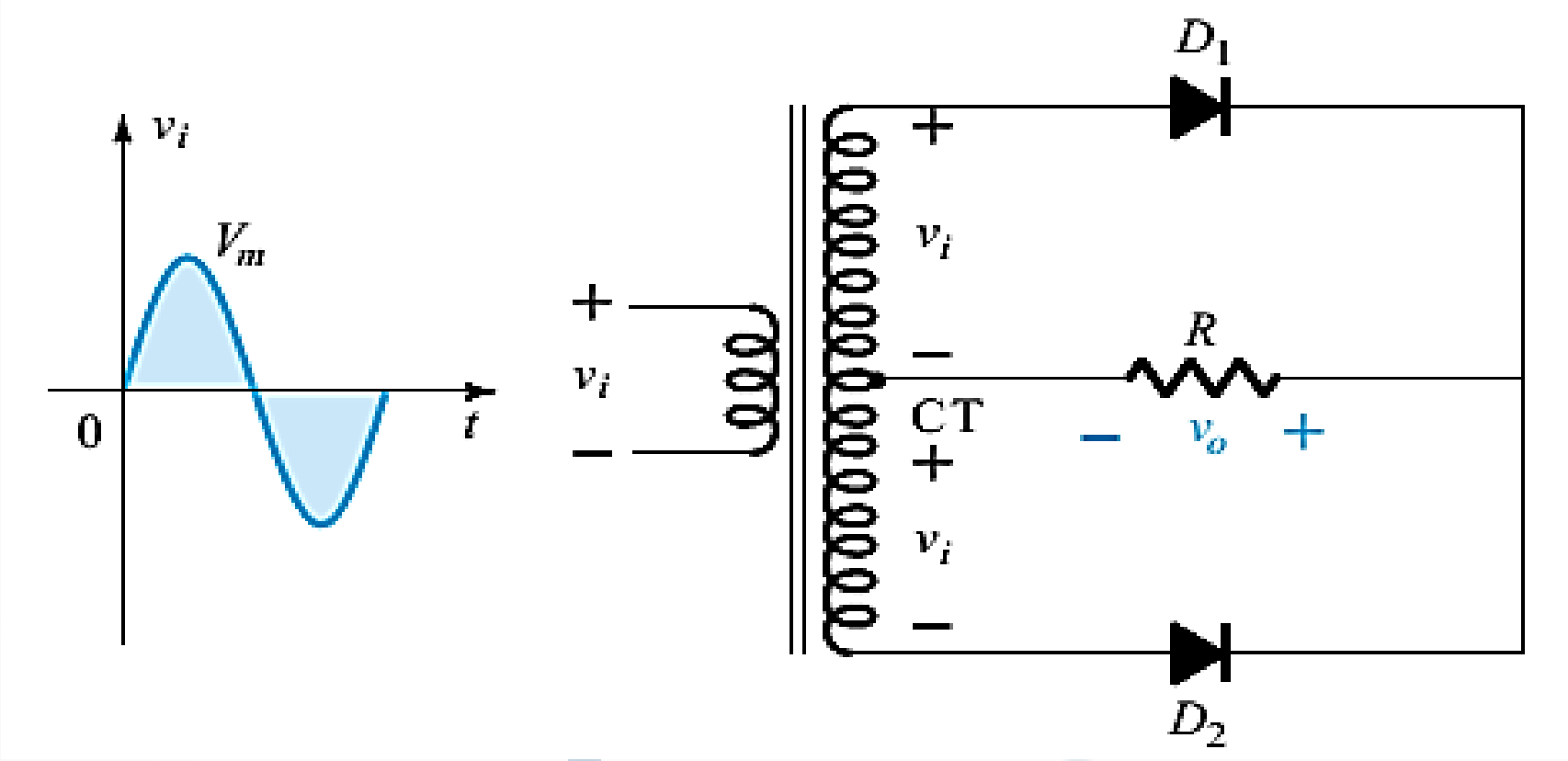


$V_{dc} = 0.636\, V_m$

- **Half-wave: $V_{dc} = 0.318\, V_m$**
- **Full-wave: $V_{dc} = 0.636\, V_m$**

Center-Tapped Transformer

مقوم موجة كاملة
باستخدام النقطة الوسطى للمحـــول:



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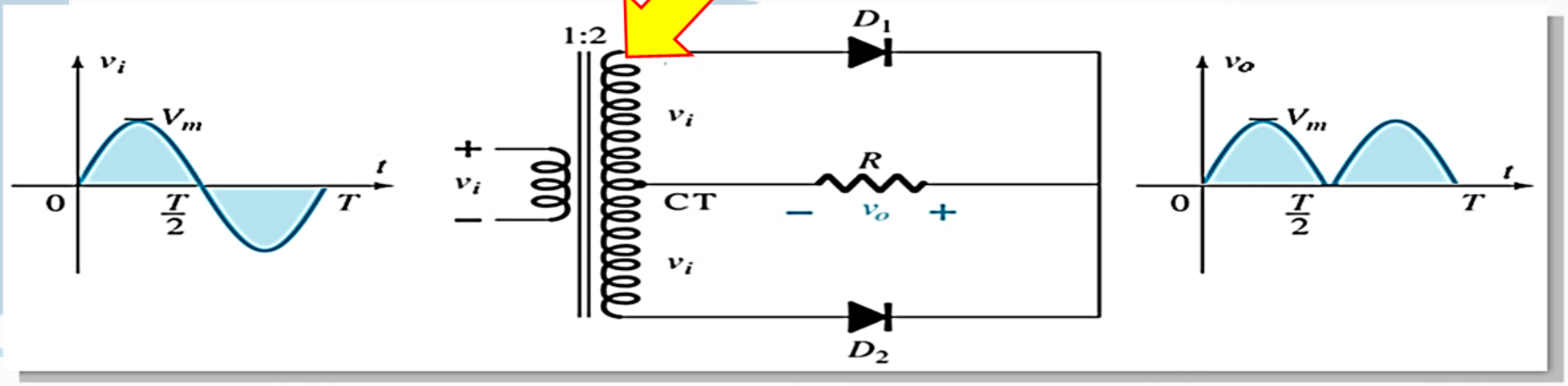
Full-Wave Rectification

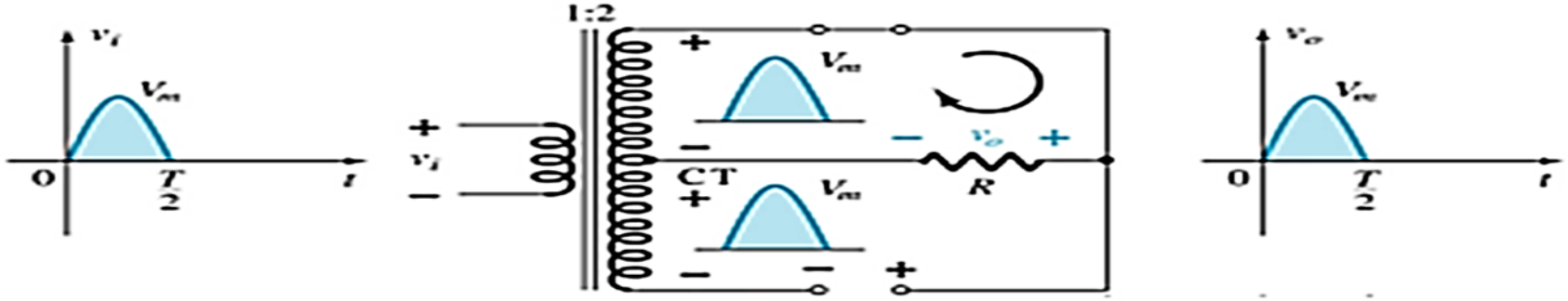
Center-Tapped Transformer Rectifier

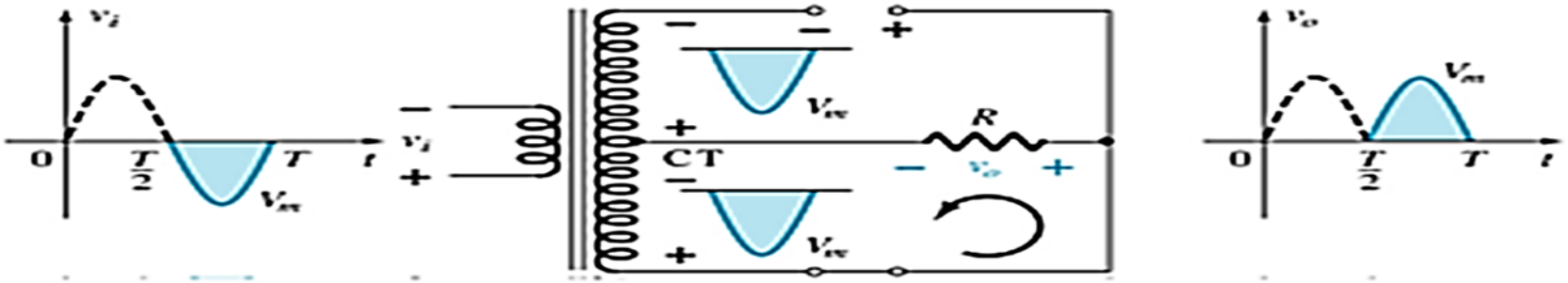
Requires

- **Two diodes**
- **Center-tapped transformer**

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

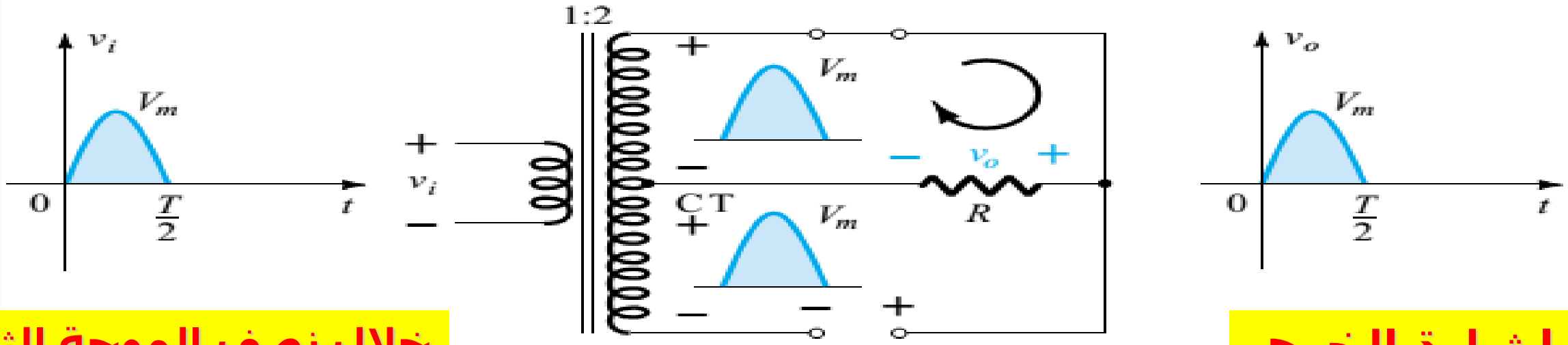






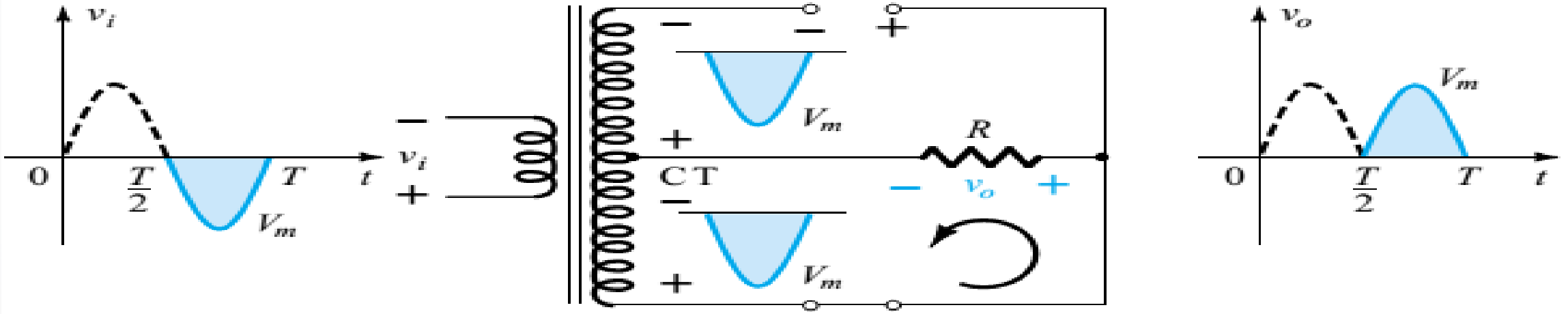
تحليل عمل دارة التقويم

خلال نصف الموجة الاول



خلال نصف الموجة الثاني

اشارة الخرج



القيمة المتوسطة لإشارة جهد الخرج لدارة تقويم موجة كاملة

$$V_{dc} \approx 0.636(V_{m2} - V_T)$$

حيث: V_{m2} تمثل القيمة العظمى للجهد على ثانوي المحول

تتحدد V_{m2} من نسبة تحويل المحول $K_T = \frac{N_1}{N_2} = \frac{V_{m1}}{V_{m2}} =$

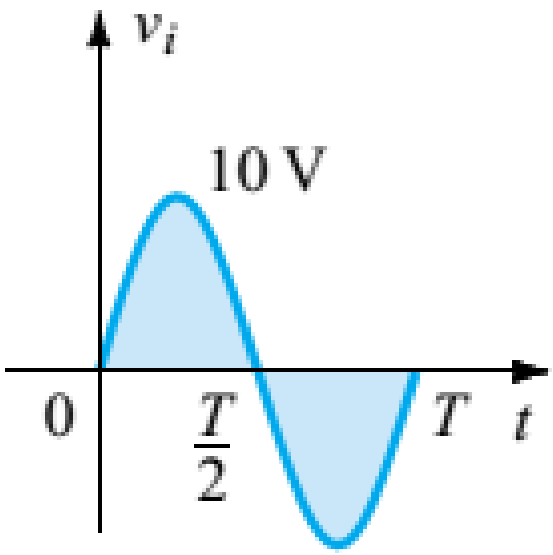
حيث: V_{m1} تمثل القيمة العظمى للجهد على ابتدائي المحول

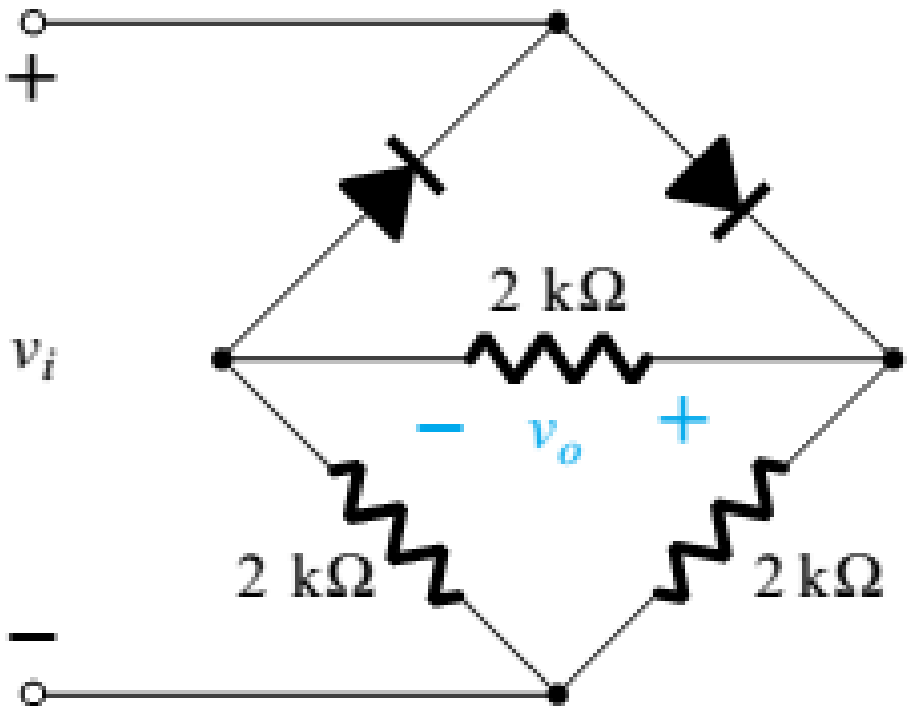
الجهد العكسي الاعظمي للديود

$\text{PIV} \geqq 2V_m$	CT transformer, full-wave rectifier

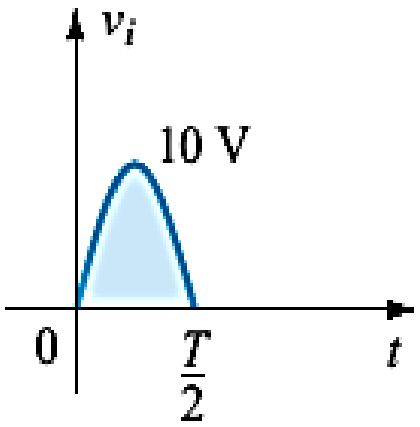
تطبيق

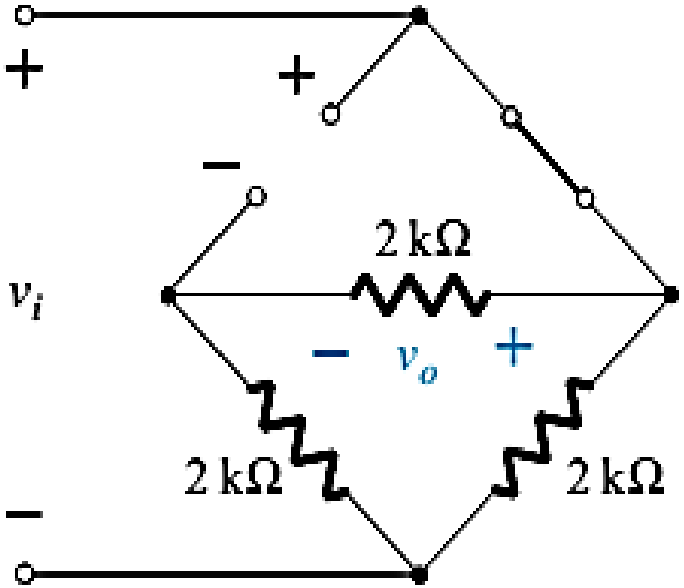
Determine the output waveform for the network and calculate the output dc level and the required PIV of each diode.

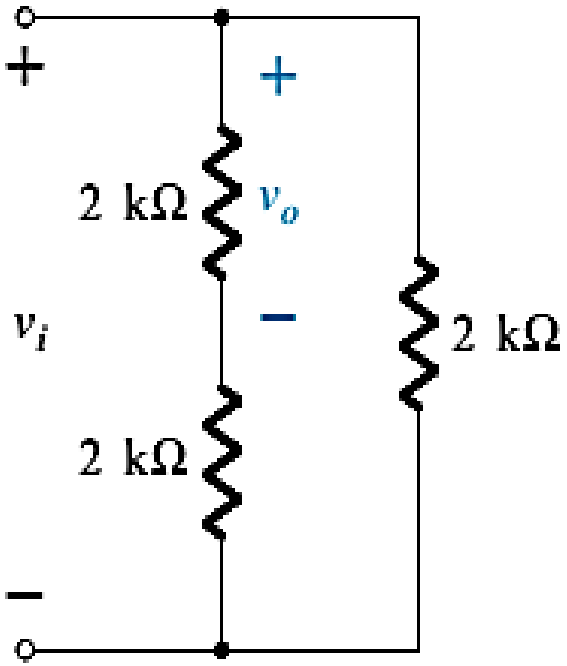


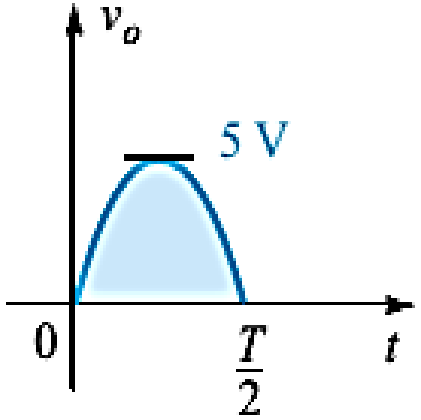


خلال نصف الموجة الاول

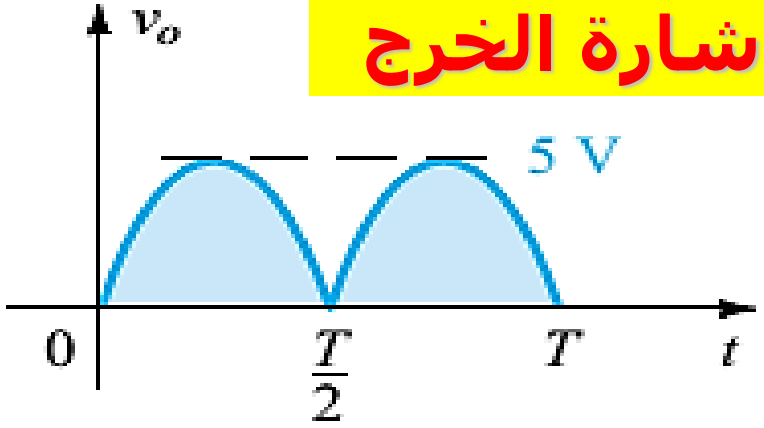








اشارة الخرج



$$V_{dc} = 0.636(5\ \text{V}) = 3.18\ \text{V}$$

القيمة المتوسطة لإشارة جهد الخرج

Summary of Rectifier Circuits

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 = peak of the AC voltage.

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