Electronic Devices

Lecture 7
P-N Junction

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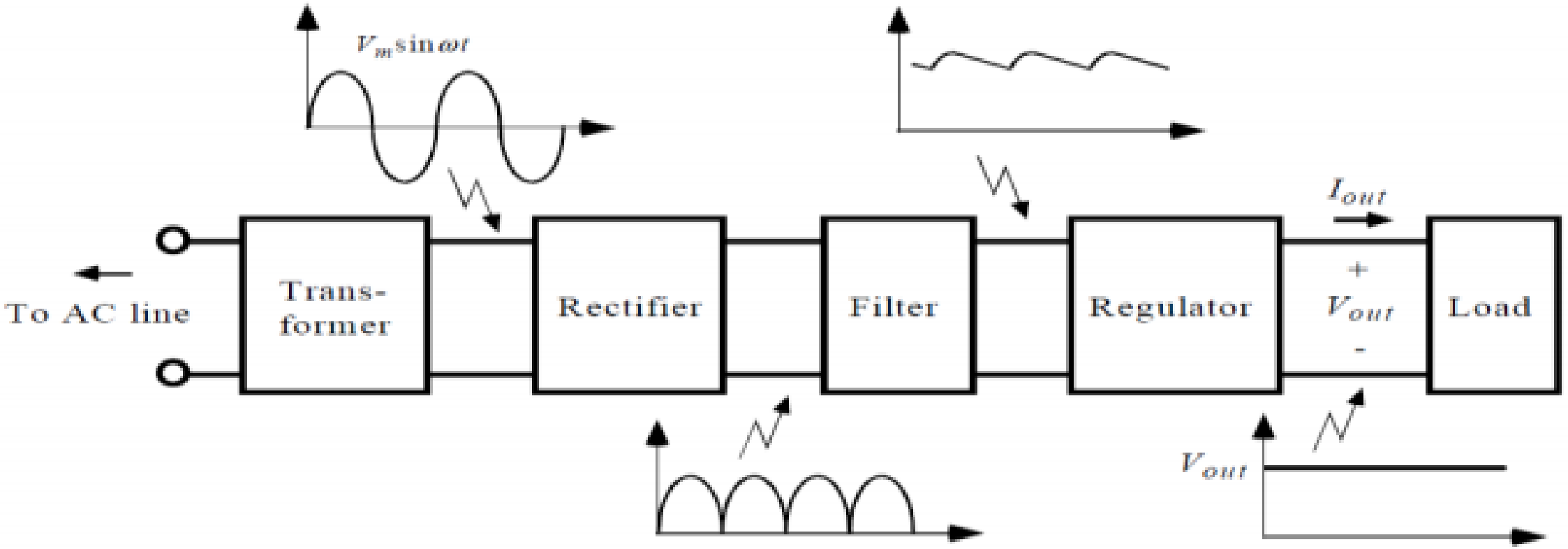
Diode Applications

- **Rectifying**
- Clipping
- Clamping

Rectifiers

- Rectifier circuit rectifies the Ac signal into DC signal, the most known example is the power supply.



Components of a typical linear power supply

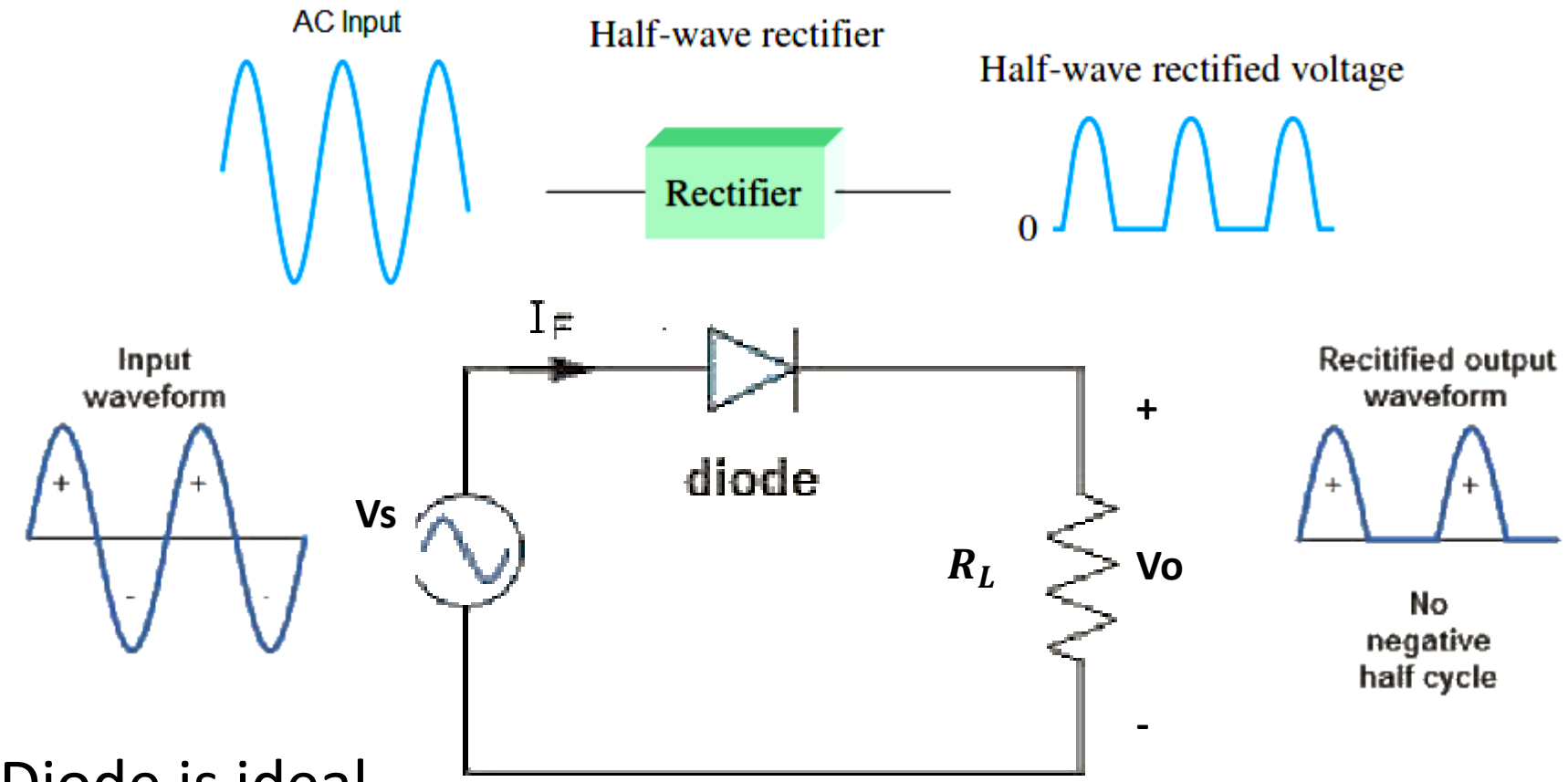
Rectifier

- A basic rectifier converts an AC voltage to a pulsating DC voltage.
- A filter then eliminates AC components of the wave form to produce a nearly constant DC voltage output.
- Rectifier circuits are used in virtually all electronic devices to convert the 220V 50Hz AC power line source to the DC voltages required for operation of electronic devices.
- In rectifier circuits, the diode state changes with time and a given piecewise line model is valid only a certain time interval.

Rectifier Circuits

- Half wave rectifier
- Full wave rectifier
- Bridge rectifier.

Halfwave rectifier



Assuming Diode is ideal

Vs >0 → D is ON (short circuit) → Vo= Vs

Vs < 0 → D is Off (open circuit) → Vo= 0

Halfwave rectifier

Assume diode is real one “ Practical”, the piecewise linear model is used.

Vs < Vɣ → D is OFF (open circuit)

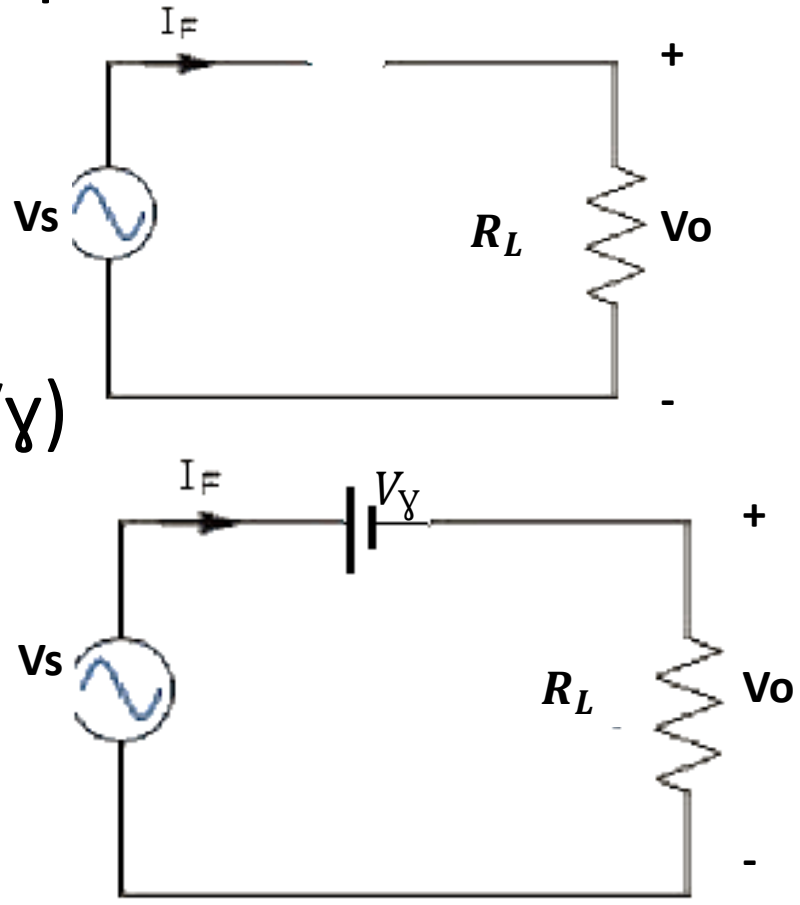
Vo=0

Vs > Vɣ → D is ON (replace diode with Vɣ)

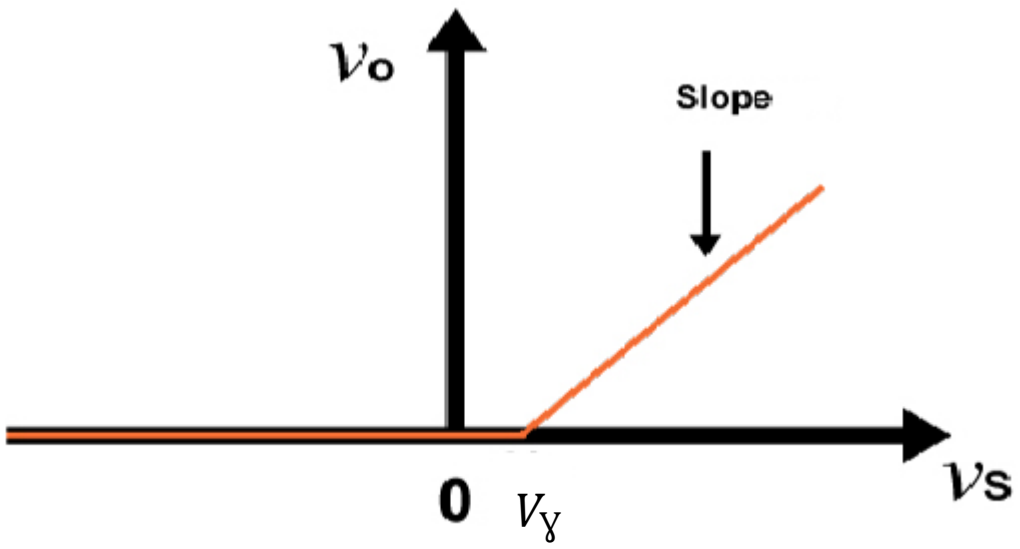
By KVL

-Vs + Vɣ + Vo = 0

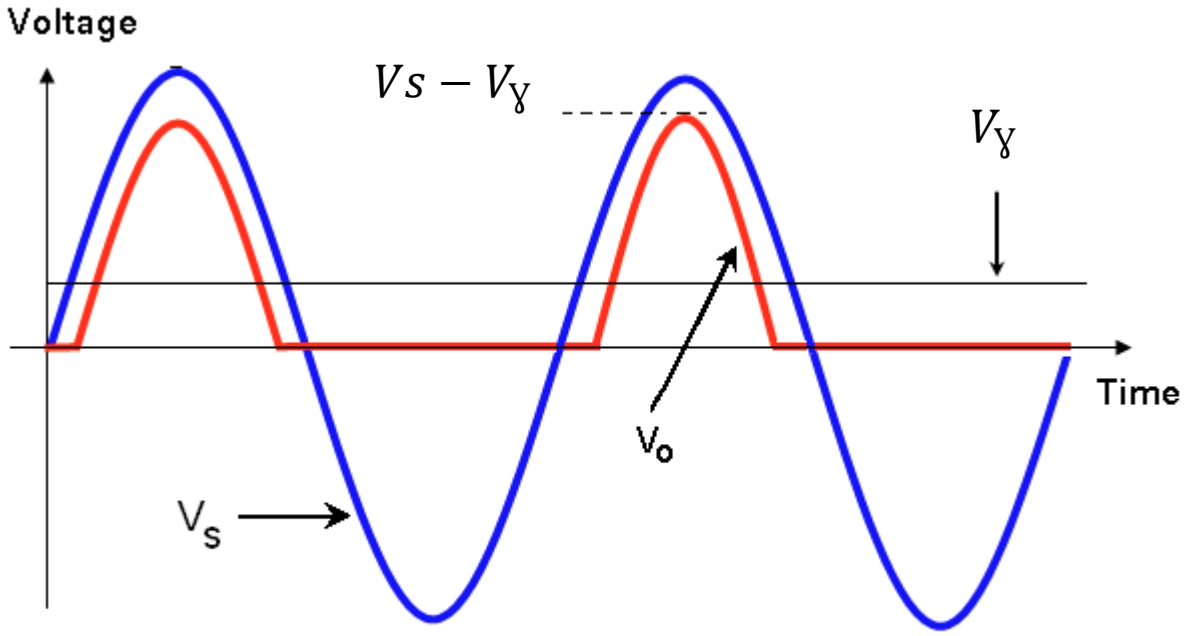
Vo= Vs - Vɣ



Halfwave rectifier

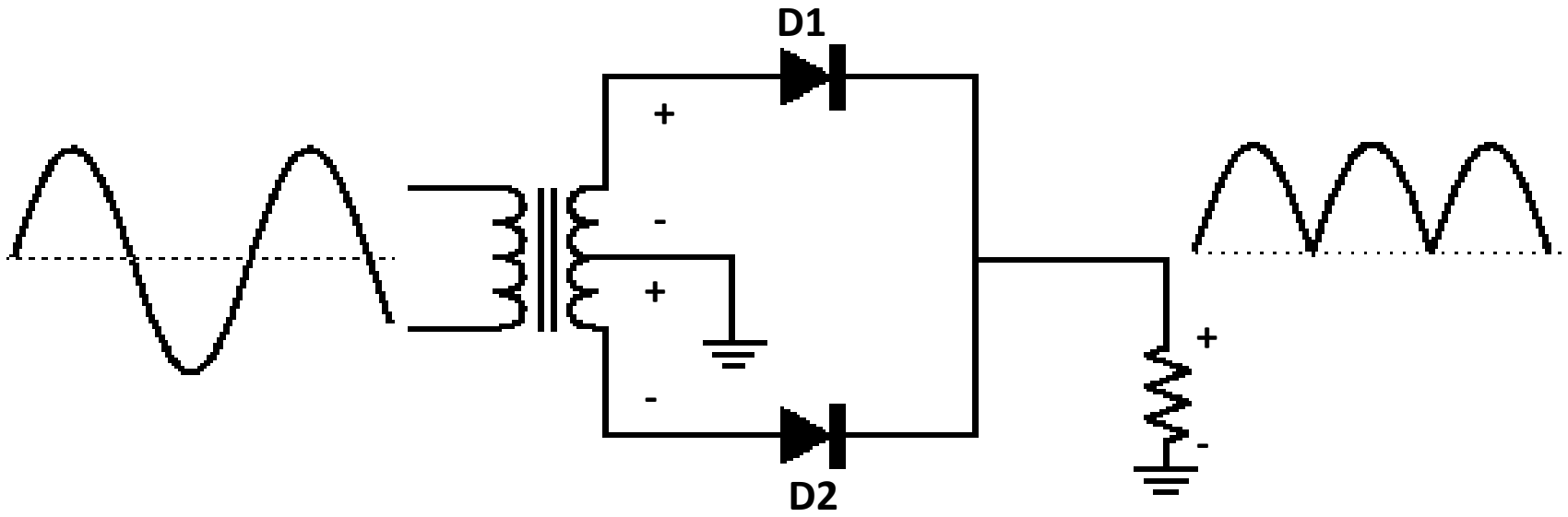


Transfer characteristics



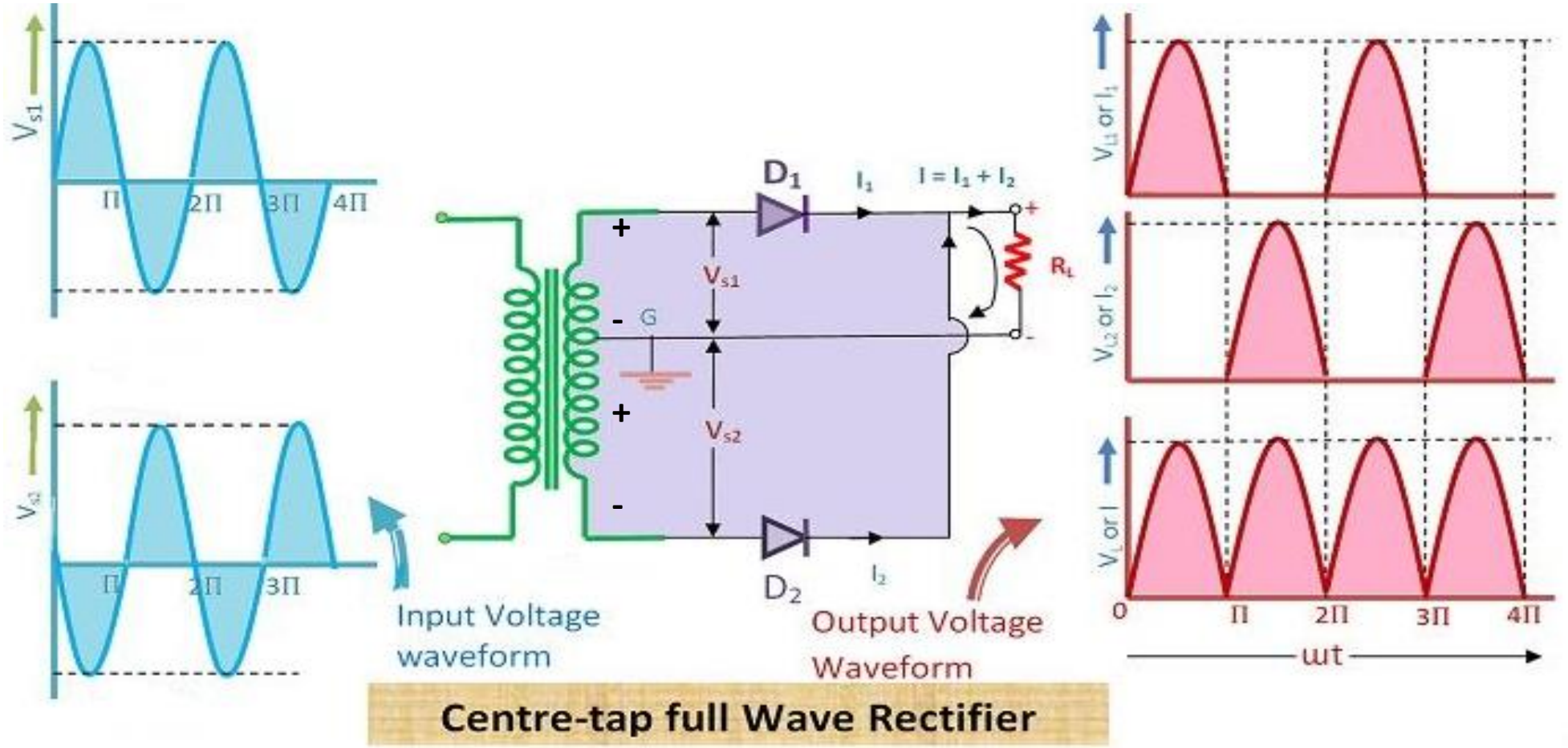
Input & output waveform

Full wave rectifier “ Center tap”



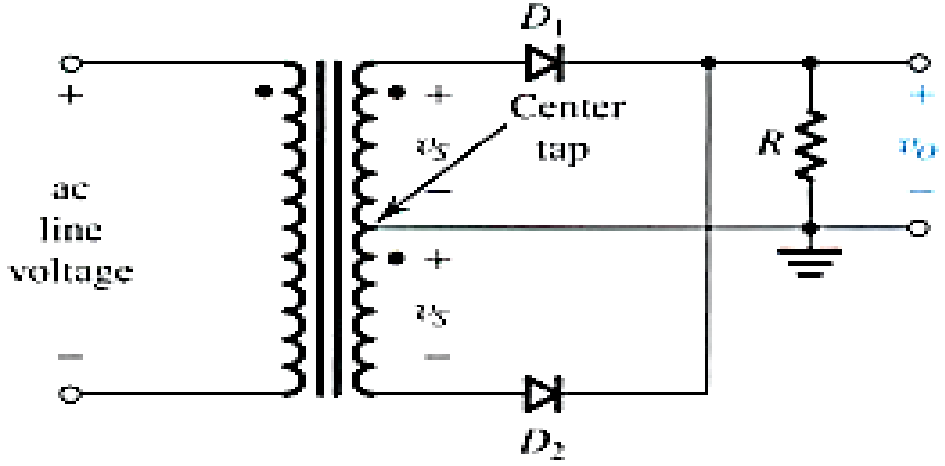
- Two half wave circuits make a Full wave rectifier circuit.
- D1 and D2 are not working together.

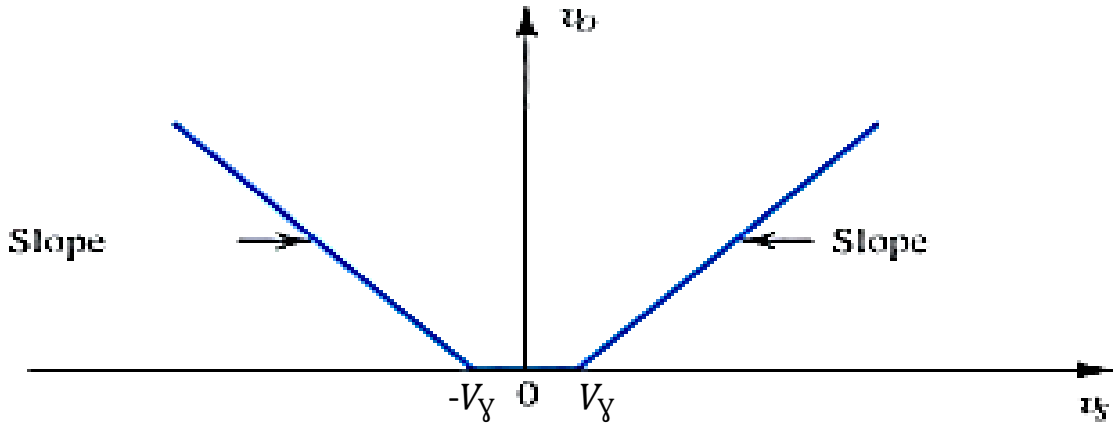
Full wave rectifier " Center tap"



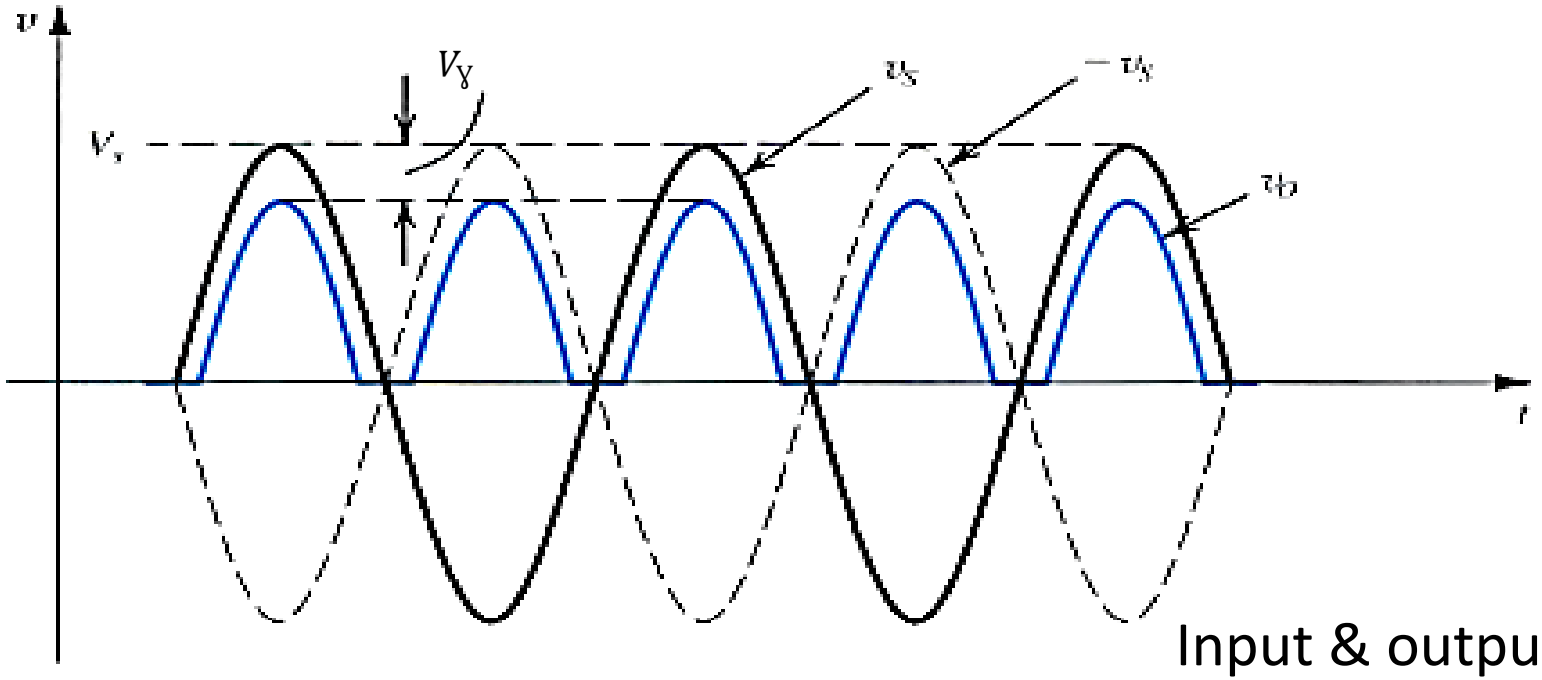
- if Vs >Vɣ → D1 is ON & Vo= Vs - Vɣ
- If Vs < - Vɣ → D2 is ON & Vo= -(Vs- Vɣ)
- If - Vɣ <Vs< Vɣ→ D1 & D2 are OFF & Vo= 0

Full wave rectifier “ Center tap”





Transfer characteristics



Input & output waveform

Bridge Rectifier

- For positive half cycle (Vs > 2Vɣ)

D1 & D2 are ON D3 & D4 are OFF

Vo= Vs -2Vɣ

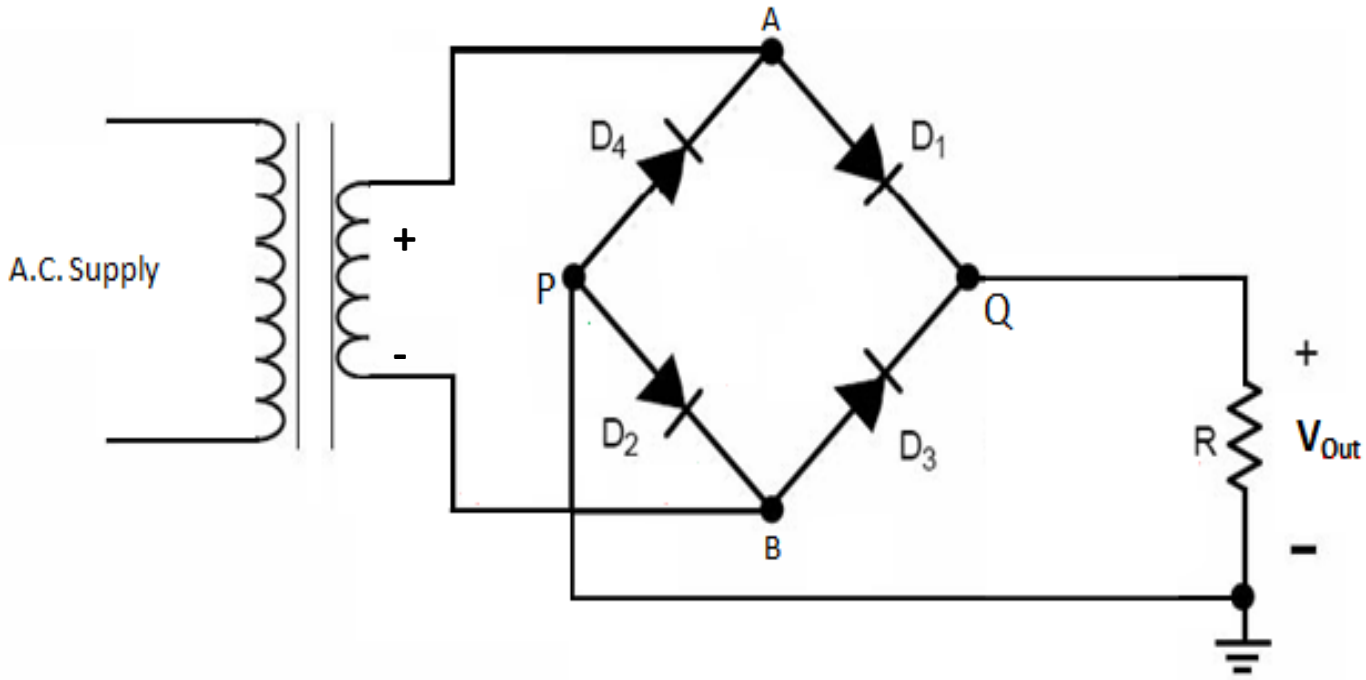
- For negative half cycle (Vs <- 2Vɣ)

D1 & D2 are OFF D3 & D4 are ON

Vo=-(Vs -2Vɣ)

- -2Vɣ <Vs< 2Vɣ all D are off

Vo=0



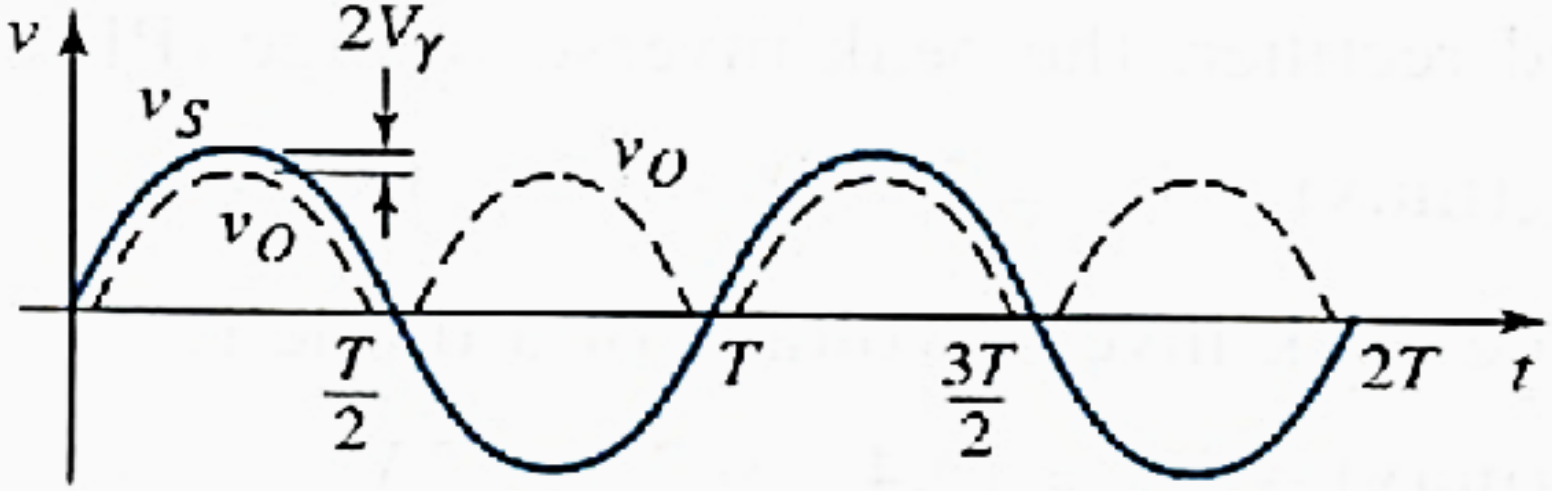
Bridge Rectifier

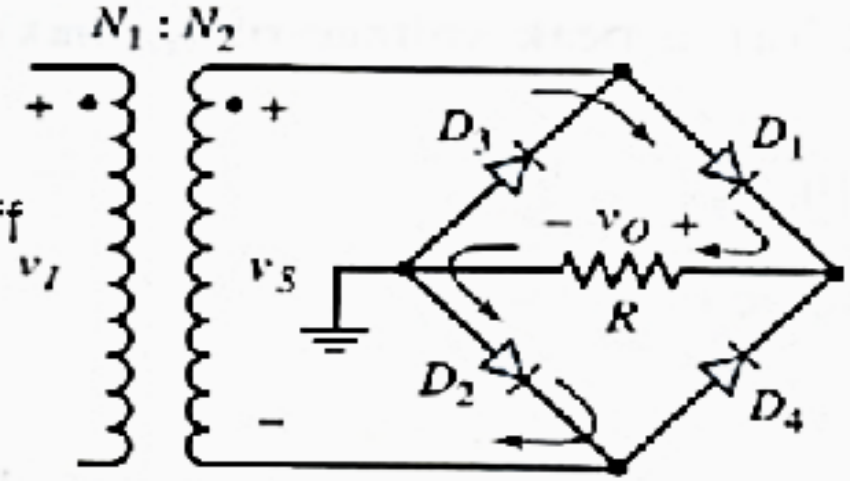
- $V_s > 2V_\gamma$, D_1 and D_2 conducts, D_3 and D_4 off:

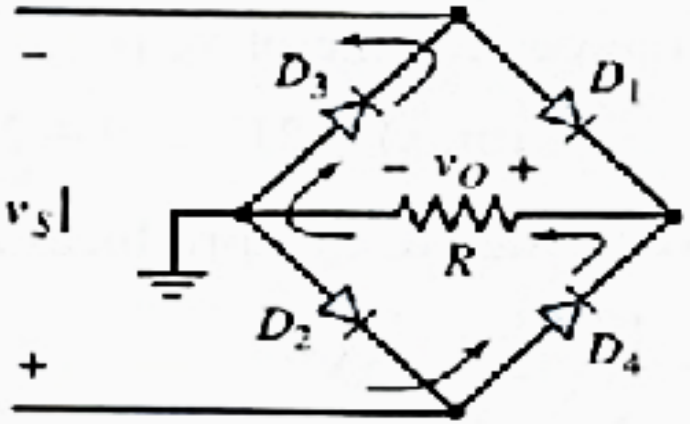
$$V_o = V_s - 2V_\gamma$$

- $V_s < -2V_\gamma$, $D3$ and $D4$ conducts, $D1$ and $D2$ off

$$V_o = -(V_s - 2V_\gamma)$$

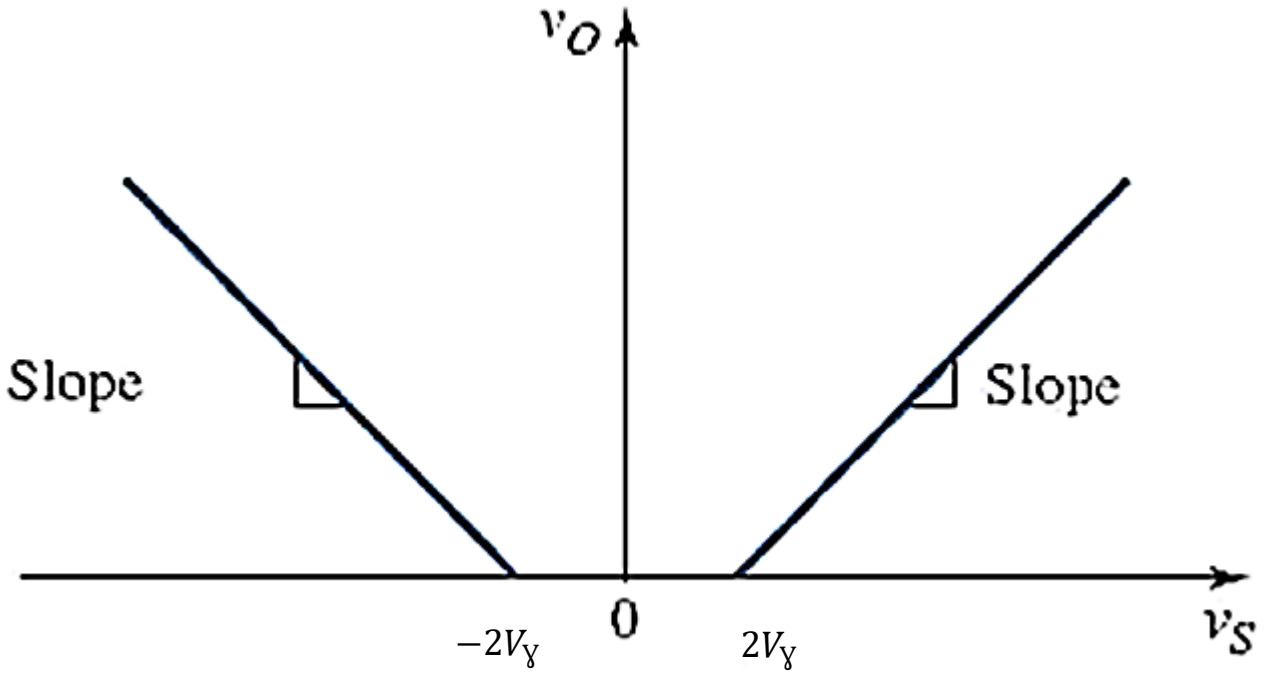






Input & output waveform

Bridge Rectifier



Transfer characteristics

Rectifier with filter