Announcements

- Exam 1 on Monday April 28 (one week).
  - HW 1-3, Chapters 1-3.
- Lab reports due in lab section.
  - For guidelines/template see Lab web page.

Diode Power Dissipation

- Power Dissipation due to turn on voltage

$$P_D = \frac{1}{T}\int_0^T v_D(t) i_D(t) dt$$

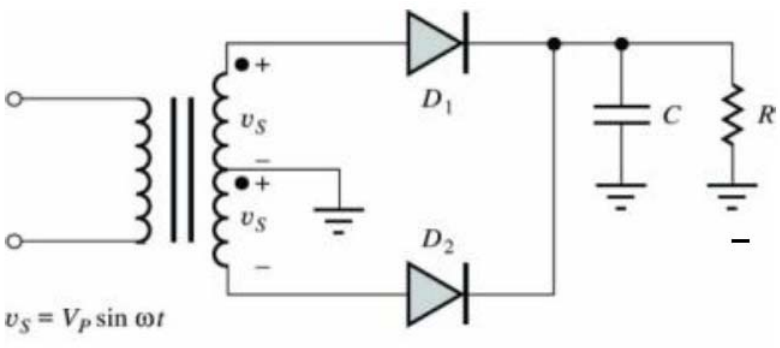
- Assuming constant voltage drop of V_{on}

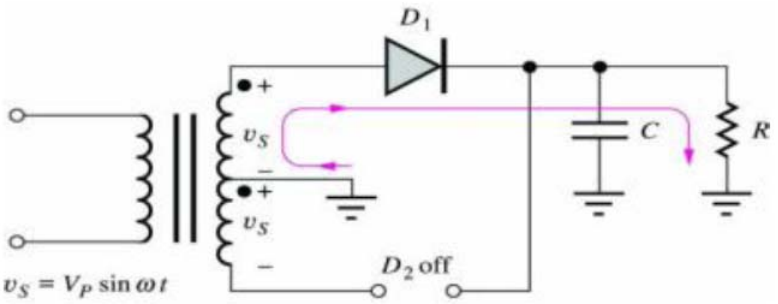
$$P_D = V_{\text{on}} I_{dc}$$

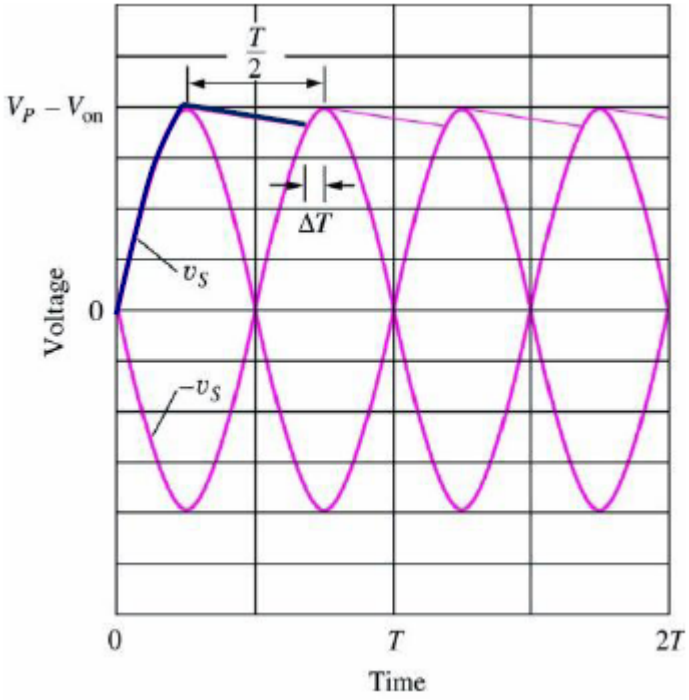
- Power dissipation due to resistive loss (R_S)

$$P_D = \frac{1}{T}\int_0^T i_D^2(t) R_s dt \approx \frac{4}{3}\frac{T}{\Delta T} I_{dc}^2 R_S$$

Full-wave rectifier
Center Tapped Transformer





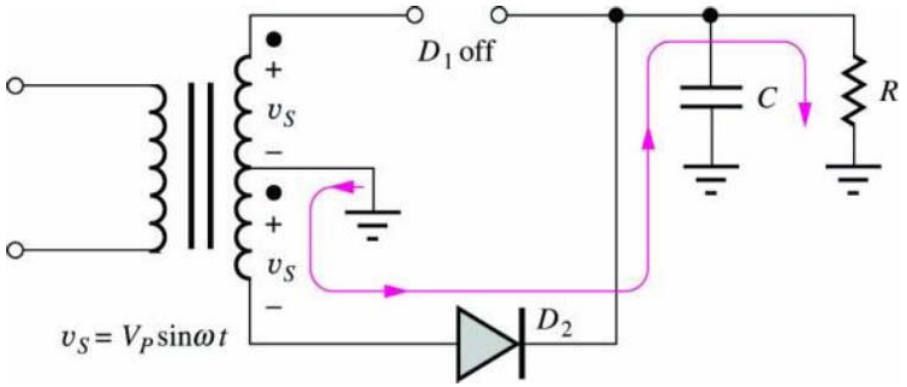


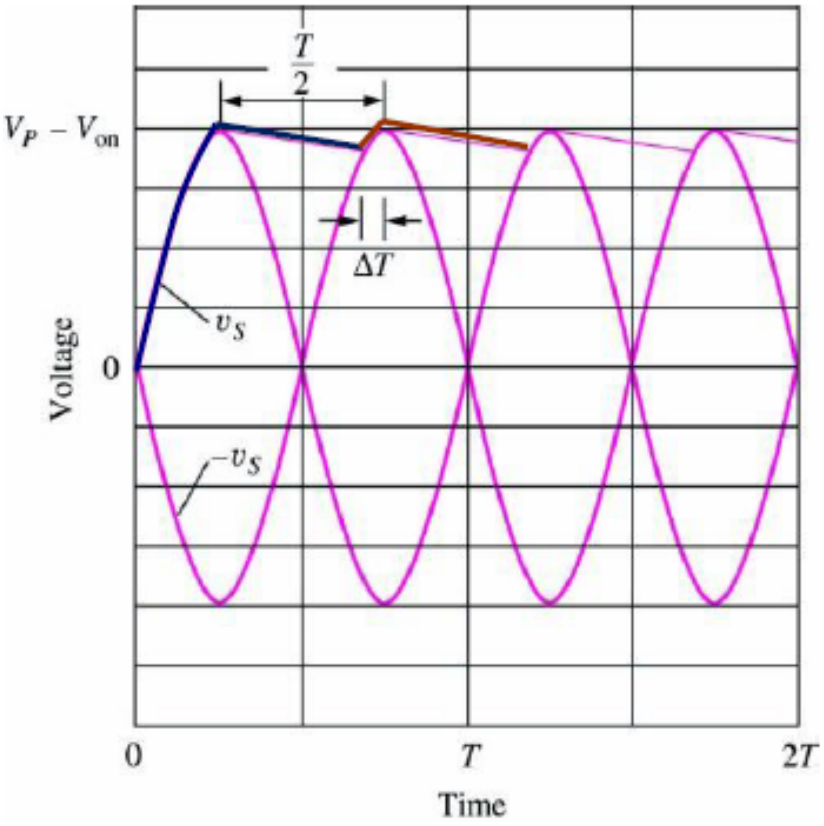
Diodes D_1 and D_2 conduct on opposite half cycles

When $v_s(t) \geq V_{\text{on}} + v_C(t)$, D_1 ON, D_2 OFF

After $t = \frac{T}{4}$, $v_C(t) > v_s(t)$. D_1 OFF, capacitor starts to discharge

Full-wave rectifier
Center Tapped Transformer



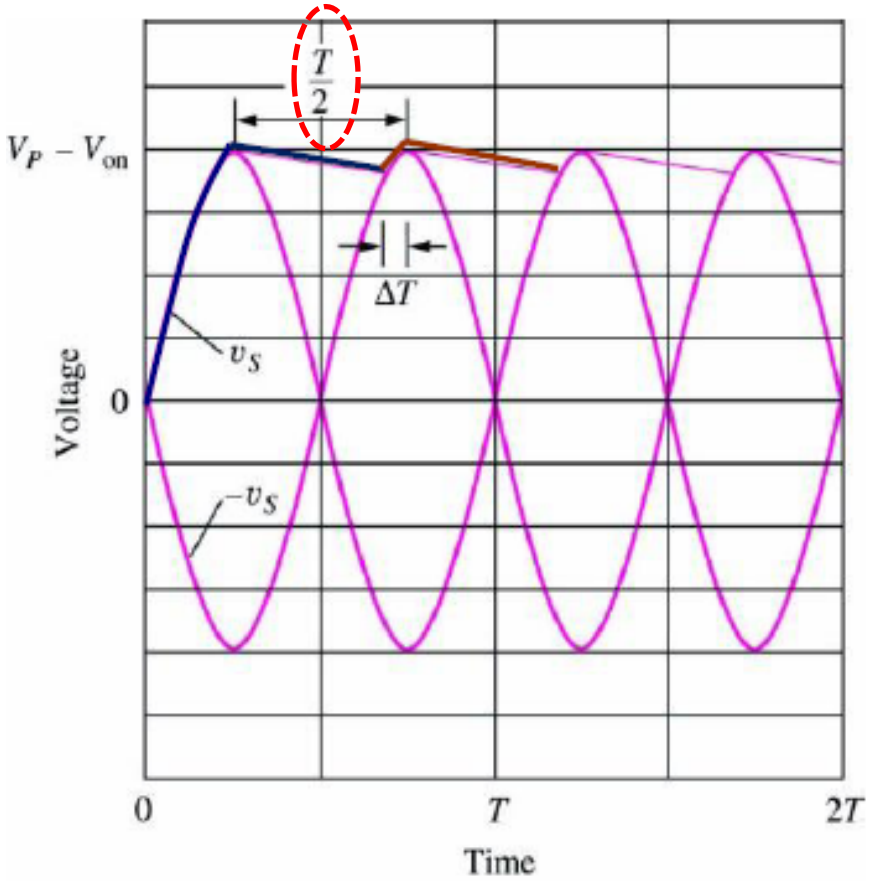


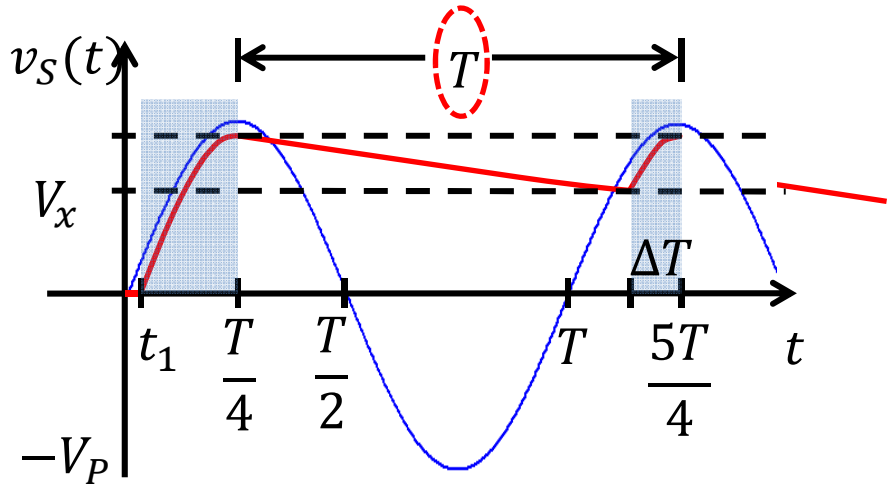
When $v_s(t) < 0$, D_1 OFF.

When $-v_s(t) = v_C(t) + V_{on}$, D_2 ON, capacitor starts to charge.

At $t = \frac{3T}{4}$, $|v_s(t)| \leq v_C(t) + V_{on}$, D_2 OFF, capacitor starts to discharge.

Full-wave rectifier v.s. Half-wave rectifier





Full-wave rectifiers cut capacitor discharge time in half, and require half the filter capacitance to achieve a given ripple voltage.

$$V_r = \frac{V_P - V_{on}}{RC}\frac{T}{2}, \Delta T = \frac{1}{\omega}\sqrt{\frac{2V_r}{V_P}}$$

Full vs Half Wave

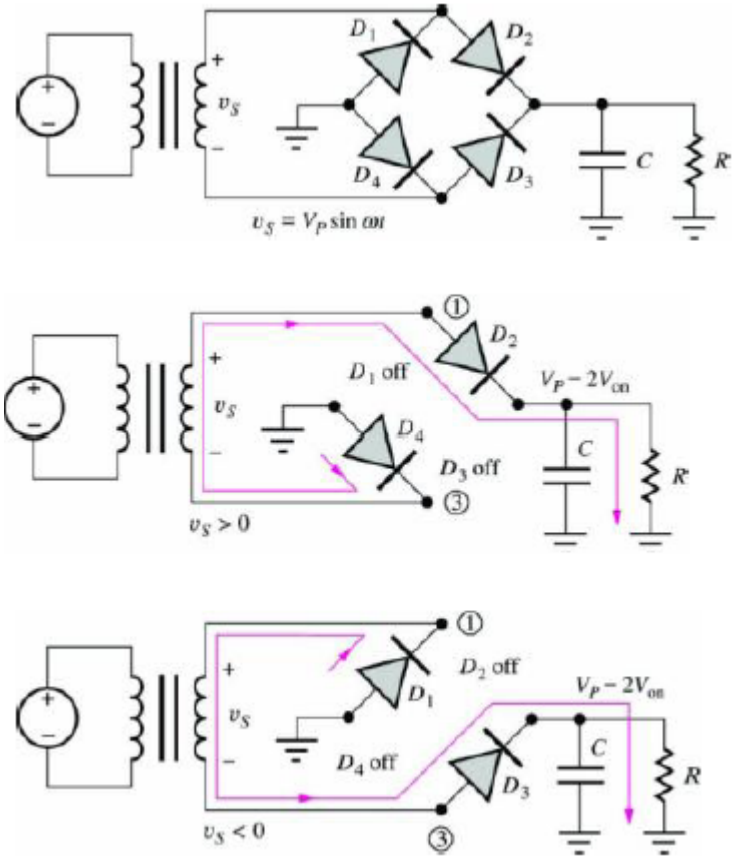
- Full wave allows smaller C, but center-tapped transformer, extra diode.
- Power in diode unchanged (half the current, twice as often)

$$P_D = V_{\text{on}} I_{dc}$$

- Higher voltages across any series resistances (transformer, diode), more power dissipation

$$P_D = \frac{1}{T}\int_0^T i_D^2(t) R_s dt$$

Full-wave Bridge Rectifier



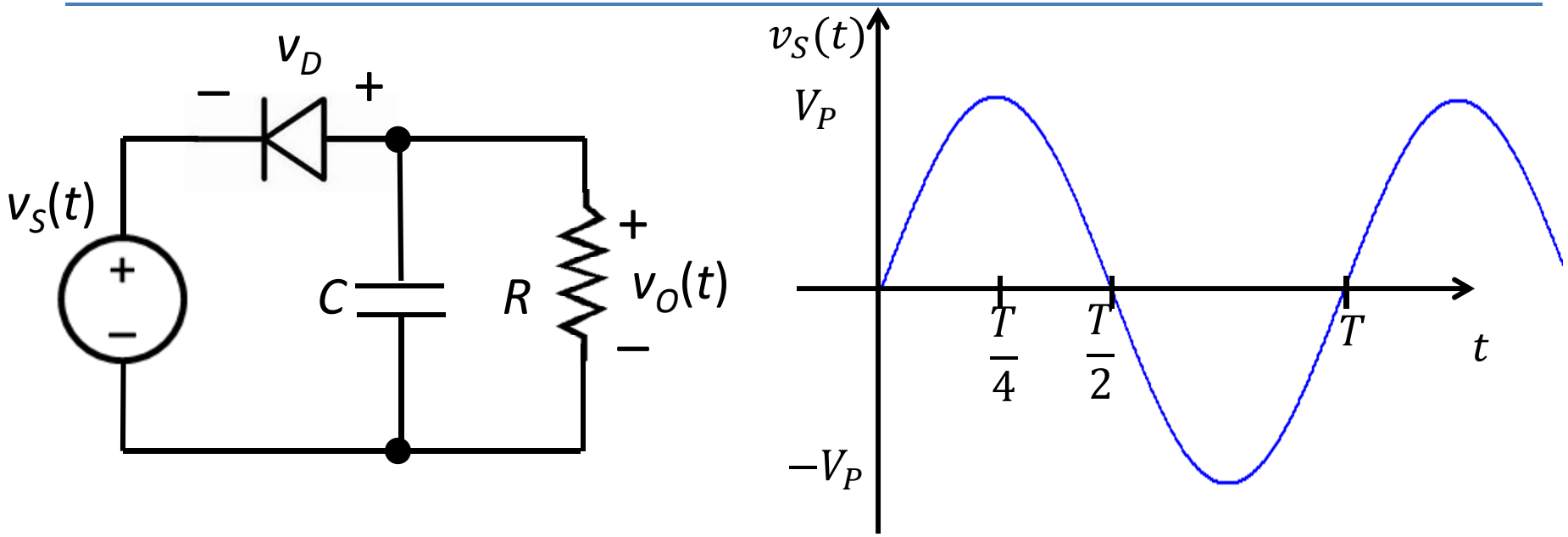
The requirement for a center-tapped transformer in the full-wave rectifier is eliminated through use of 2 extra diodes.

KVL: $v_C + V_{\text{on}} - v_s + V_{\text{on}} = 0$

$$V_r = \frac{V_P - 2V_{\text{on}}}{RC}\frac{T}{2}$$

$$\Delta T = \frac{1}{\omega}\sqrt{\frac{2V_r}{V_P}}$$

Half-wave rectifier w/ RC Load



What would happen if diode was flipped (as shown)?

How about series resistance?

