Discussion 3 Notes

Friday, April 15, 2022 8:16 PM

Direct Current (DC)

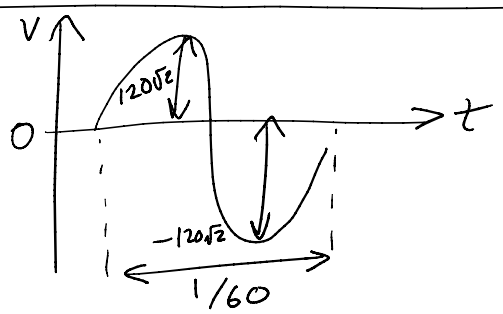
$V = 5V$, $I = 1A$

Alternating Current (AC)

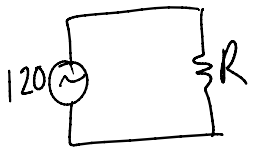
$V = 5\sin(\omega t)$, $I = \cos(\omega t)$

120VAC, 60Hz

(110-120) (50-60)

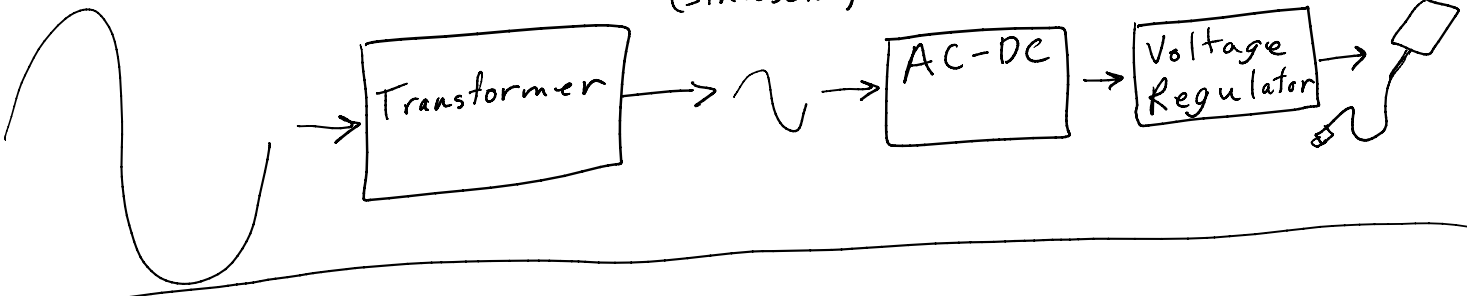


RMS Voltage



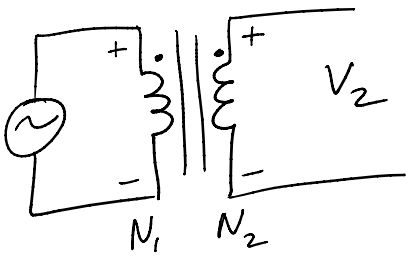
$P = \frac{V^2}{R}$

$V_{RMS} = V_A \frac{1}{\sqrt{2}}$ (sinusoid)

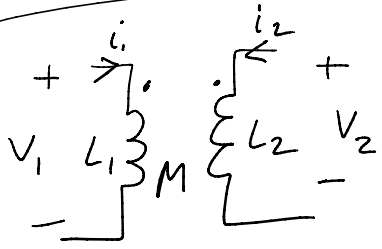


Ideal Transformer

$V_2 = \frac{N_2}{N_1} V_1$, $i_2 = -\frac{N_1}{N_2} i_1$

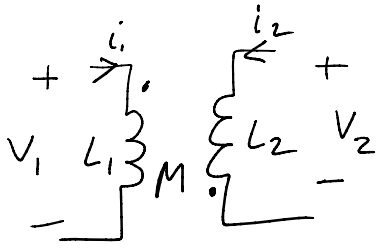


Mutual Inductance

① 

$V_1 = L_1 \frac{di_1}{dt} + M \frac{di_2}{dt}$

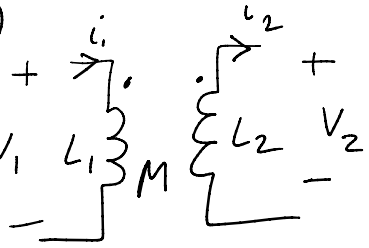
$V_2 = L_2 \frac{di_2}{dt} + M \frac{di_1}{dt}$

② 

$V_1 = L_1 \frac{di_1}{dt} - M \frac{di_2}{dt}$

$V_2 = L_2 \frac{di_2}{dt} - M \frac{di_1}{dt}$

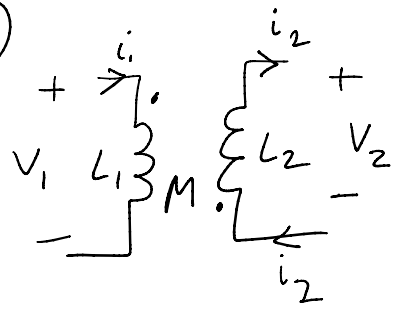
③



$$V_1 = L_1\frac{di_1}{dt} + M\frac{d(i_2)}{dt} = L_1\frac{di_1}{dt} - M\frac{di_2}{dt}$$

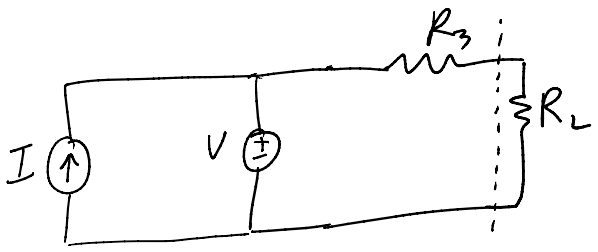
$$V_2 = L_2\frac{d(i_2)}{dt} + M\frac{di_1}{dt} = -L_2\frac{di_2}{dt} + M\frac{di_1}{dt}$$

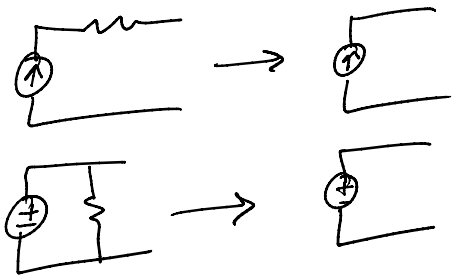
④



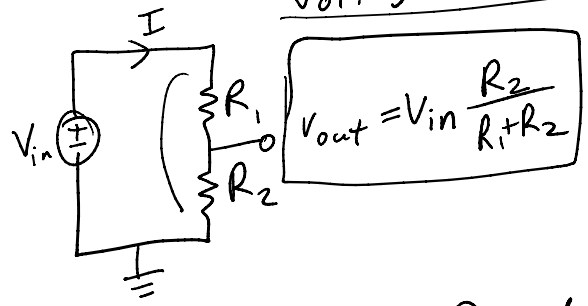
$$V_1 = L_1\frac{di_1}{dt} + M\frac{di_2}{dt}$$

$$V_2 = -L_2\frac{di_2}{dt} - M\frac{di_1}{dt}$$





Voltage Divider

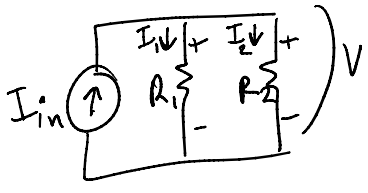


$$V_{out} = V_{in}\frac{R_2}{R_1+R_2}$$

$$I = \frac{V_{in}}{R_1+R_2}$$

$$V_{out} = IR_2 = \frac{V_{in}R_2}{R_1+R_2}$$

Current Divider



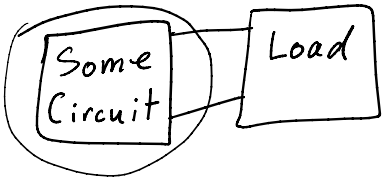
$$I_1 = I_{in}\frac{R_2}{R_1+R_2}$$

$$I_2 = I_{in}\frac{R_1}{R_1+R_2}$$

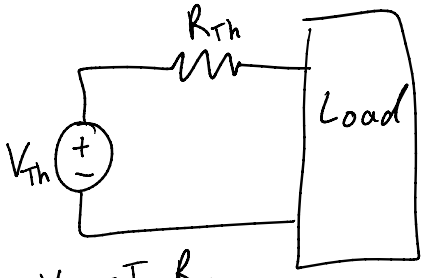
$$V = I\frac{R_1R_2}{R_1+R_2}$$

$$I_1 = \frac{V}{R_1} = I\frac{R_2}{R_1+R_2}$$

$$I_2 = \frac{V}{R_2} = I\frac{R_1}{R_1+R_2}$$



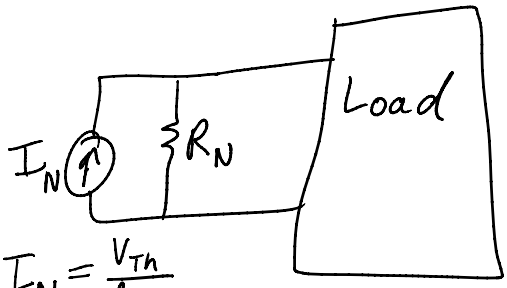
Thevenin



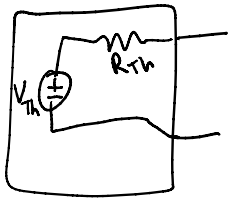
$V_{Th} = I_N R_N$

$R_{Th} = R_N$

Norton



$I_N = \frac{V_{Th}}{R_{Th}}$

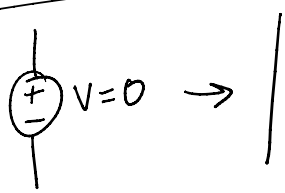


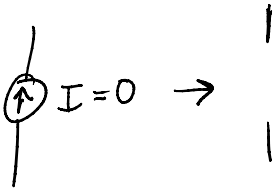
Open Circuit Voltage

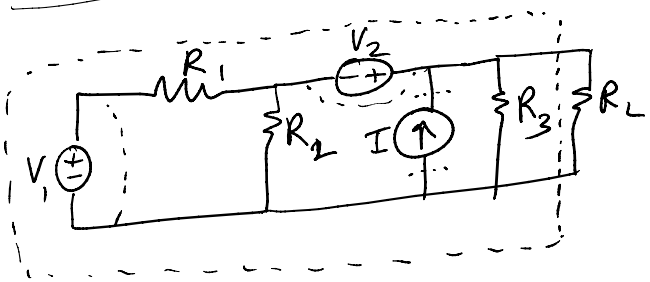
$V_{oc} = V_{Th}$

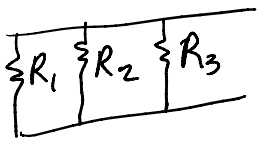
Short Circuit Current

$I_{sc} = I_N$









R_{eq} ?

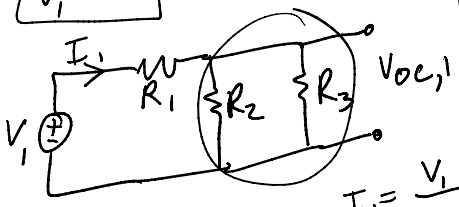
$$R_{eq} = R_1 \| R_2 \| R_3$$

$$R_{Th} = R_N = R_{eq} = \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

Superposition

$$V_{oc} = V_{oc,1} + V_{oc,2} + V_{oc,3}$$

V_1 On



$$I_1 = \frac{V_1}{R_1 + R_2 \| R_3}$$

$$V_{oc,1} = V_1 \frac{R_2 \| R_3}{R_1 + R_2 \| R_3}$$

$$V_{oc,1} = V_1 - I_1 R_1$$

$$V_{oc,1} = V_1 - \frac{V_1 R_1}{R_1 + R_2 \| R_3}$$

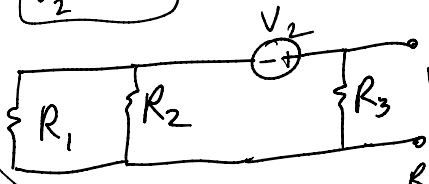
$$V_{oc,1} = V_1 \left(1 - \frac{R_1}{R_1 + R_2 \| R_3}\right)$$

$$V_{oc,1} = V_1 \frac{R_2 \| R_3}{R_1 + R_2 \| R_3}$$

$$V_{oc,1} = \frac{V_1 \frac{R_2 R_3}{R_2 + R_3}}{R_1 + \frac{R_2 R_3}{R_2 + R_3}}$$

$$V_{oc,1} = \frac{V_1 R_2 R_3}{R_1 R_2 + R_1 R_3 + R_2 R_3}$$

V_2 On



$$V_{oc,2} = V_2 \frac{R_3}{R_3 + R_1 \| R_2}$$

$$V_{oc,2} = \frac{V_2 R_3}{R_3 + \frac{R_1 R_2}{R_1 + R_2}}$$

$$V_{oc,2} = \frac{V_2 R_3 (R_1 + R_2)}{R_1 R_3 + R_2 R_3 + R_1 R_2}$$

I On

$$V_{oc,3} = I (R_1 \| R_2 \| R_3)$$

$$V_{oc,3} = I \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

$$V_{Th} = V_{oc} = V_{oc,1} + V_{oc,2} + V_{oc,3} = \frac{V_1 R_2 R_3 + V_2 R_3 (R_1 + R_2) + I R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

$$I_N = \frac{V_{Th}}{R_{Th}}$$