Chapter 2 Summary
Electric Circuits and Components

current (A): $$I(t) = \frac{dq}{dt}$$

ohm's law (V): $$V = IR$$

resistor value (Ω): $$R = ab \times 10^c \pm \text{tolerance (\%)}$$

***a, b,* and *c* Bands**	
Color	**Value**
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

***tol* Band**	
Color	**Value**
Gold	±5%
Silver	±10%
Nothing	±20%

capacitor (F): $$V(t) = \frac{1}{C}\int_0^t I(\tau)d\tau = \frac{Q(t)}{C} \qquad I(t) = C\frac{dV}{dt}$$

inductor (H): $$V(t) = L\frac{dI}{dt} \qquad I(t) = \frac{1}{L}\int_0^t V(\tau)d\tau$$

Kirchoff's Voltage Law (KVL): $$\sum_{i=1}^{N} V_i = 0$$

Kirchoff's Current Law (KCL): $$\sum_{i=1}^{N} I_i = 0$$

series resistors: $$R_{\text{eq}} = R_1 + R_2$$

series capacitors: $$C_{\text{eq}} = \frac{C_1 C_2}{C_1 + C_2}$$

series inductors: $$L_{\text{eq}} = L_1 + L_2$$

series resistor voltage division:

$$V_{R_1} = \frac{R_1}{R_1 + R_2} V_s, \quad V_{R_2} = \frac{R_2}{R_1 + R_2} V_s$$

parallel resistors $$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} \quad R_{\text{eq}} = \frac{R_1 R_2}{R_1 + R_2}$$

parallel capacitors: $$C_{\text{eq}} = C_1 + C_2$$

parallel inductors: $$L_{\text{eq}} = \frac{L_1 L_2}{L_1 + L_2}$$

parallel resistor current division:

$$I_1 = \frac{R_2}{R_1 + R_2} I, \quad I_2 = \frac{R_1}{R_1 + R_2} I$$

ideal voltage source: zero output resistance, can supply infinite current.

ideal current source: infinite output resistance, can supply infinite voltage.

ideal voltmeter: infinite input resistance, draws no current.

ideal ammeter: zero input resistance, no voltage drop.

ac signal: $$V(t) = V_m \sin(\omega t + \phi)$$

frequency (Hz): $$f = \frac{1}{T} = \frac{\omega}{2\pi}$$

phasor: $$V = V_m e^{j(\omega t + \phi)} = V_m \langle \phi \rangle = V_m[\cos(\omega t + \phi) + j \sin(\omega t + \phi)]$$

phasor relationships:

$$r = \sqrt{x^2 + y^2}$$

$$\phi = \tan^{-1}\left(\frac{y}{x}\right)$$

$$r_1\langle\phi_1\rangle \cdot r_2\langle\phi_2\rangle = r_1 \cdot r_2\langle\phi_1 + \phi_2\rangle$$

$$r_1\langle\phi_1\rangle / r_2\langle\phi_2\rangle = r_1 / r_2\langle\phi_1 - \phi_2\rangle$$

ac Ohm's Law with impedance: $V = ZI$

resistor impedance: $Z_R = R$

inductor impedance: $Z_L = j\omega L = \omega L\langle 90°\rangle$

capacitor impedance: $Z_C = \dfrac{1}{j\omega C} = \dfrac{-j}{\omega C} = \dfrac{1}{\omega C}\langle -90°\rangle$

power: $P = \dfrac{dW}{dt} = V\dfrac{dq}{dt} = VI$

dc resistive power: $P = VI = I^2 R = V^2/R$

rms: $I_{\text{rms}} = \sqrt{\dfrac{1}{T}\displaystyle\int_0^T I^2 dt} = \dfrac{I_m}{\sqrt{2}}$ $\quad V_{\text{rms}} = \sqrt{\dfrac{1}{T}\displaystyle\int_0^T V^2 dt} = \dfrac{V_m}{\sqrt{2}}$

ac resistive power: $P_{\text{avg}} = V_{\text{rms}} I_{\text{rms}} = R I_{\text{rms}}^2 = V_{\text{rms}}^2 / R$

transformer: $V_S = \dfrac{N_S}{N_P} V_P \quad I_S = \dfrac{N_P}{N_S} I_P$