

## Section 7: Circuits II

### 1. Capacitors in Parallel

Two capacitors,  $C_1 = 4 \mu\text{F}$  and  $C_2 = 6 \mu\text{F}$ , are connected in parallel to a 10 V battery. What is the total charge stored on the capacitors? What is the total energy stored?

### 2. Capacitors in Series

The same two capacitors ( $C_1 = 4 \mu\text{F}$  and  $C_2 = 6 \mu\text{F}$ ) are now connected in series to the 10 V battery. What is the charge on each capacitor and the voltage across each capacitor?

### 3. RLC Impedance

A series RLC circuit has  $R = 20 \Omega$ ,  $L = 10 \text{ mH}$ , and  $C = 50 \mu\text{F}$ . It is connected to an AC source with a frequency of 100 Hz. a) Calculate the inductive reactance ( $X_L$ ). b) Calculate the capacitive reactance ( $X_C$ ). c) Calculate the total impedance ( $Z$ ) of the circuit.

### 4. Resonance

For the RLC circuit in the previous problem, what is the resonant frequency? What would the impedance of the circuit be at resonance?

### 5. Transformer Currents

A transformer has a primary coil with 1000 turns and a secondary coil with 200 turns. If the primary voltage is 120 V (AC), what is the secondary voltage? If the current in the secondary is 3 A, what is the current in the primary (assuming an ideal transformer)?

### 6. AC Voltage Equation

The current in an AC circuit is given by  $I(t) = 2 \sin(120\pi t)$ . If the circuit consists of a single  $50 \Omega$  resistor, what is the equation for the voltage  $V(t)$  across it?

### 7. RC Decay

A 5 F capacitor is connected to a DC voltage source. A graph of current vs. time shows the current starts at 2A and exponentially decays to 0. What was the voltage of the source? (Hint: consider the initial state).

### 8. Capacitor Network

Find the equivalent capacitance for a circuit where a  $10 \mu\text{F}$  capacitor is in series with a parallel combination of a  $5 \mu\text{F}$  capacitor and a  $20 \mu\text{F}$  capacitor.

### 9. Semiconductor Theory

Describe the function of a semiconductor diode in a circuit. What is a “band gap” and how does it relate to conductivity?

### 10. Charge Storage

How much charge is stored on a  $100 \mu\text{F}$  capacitor when it is connected to a 20 V source?