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 $R = 20\,\Omega$, $L = 10$ 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?