Circuit Theory Analysis: The Map of Maps

a) Understand the flow of electricity in a variety electrical circuits
b) Begin to understand the flow of electrical energy in all electrical systems or media

Map 1: Electrical Circuit Structure

Determine the significant aspects of the circuit (source, elements & topology) and determine the category, or type, or circuit as well as what you expect for circuit behavior.

Map 2: Electrical Circuit Behavior

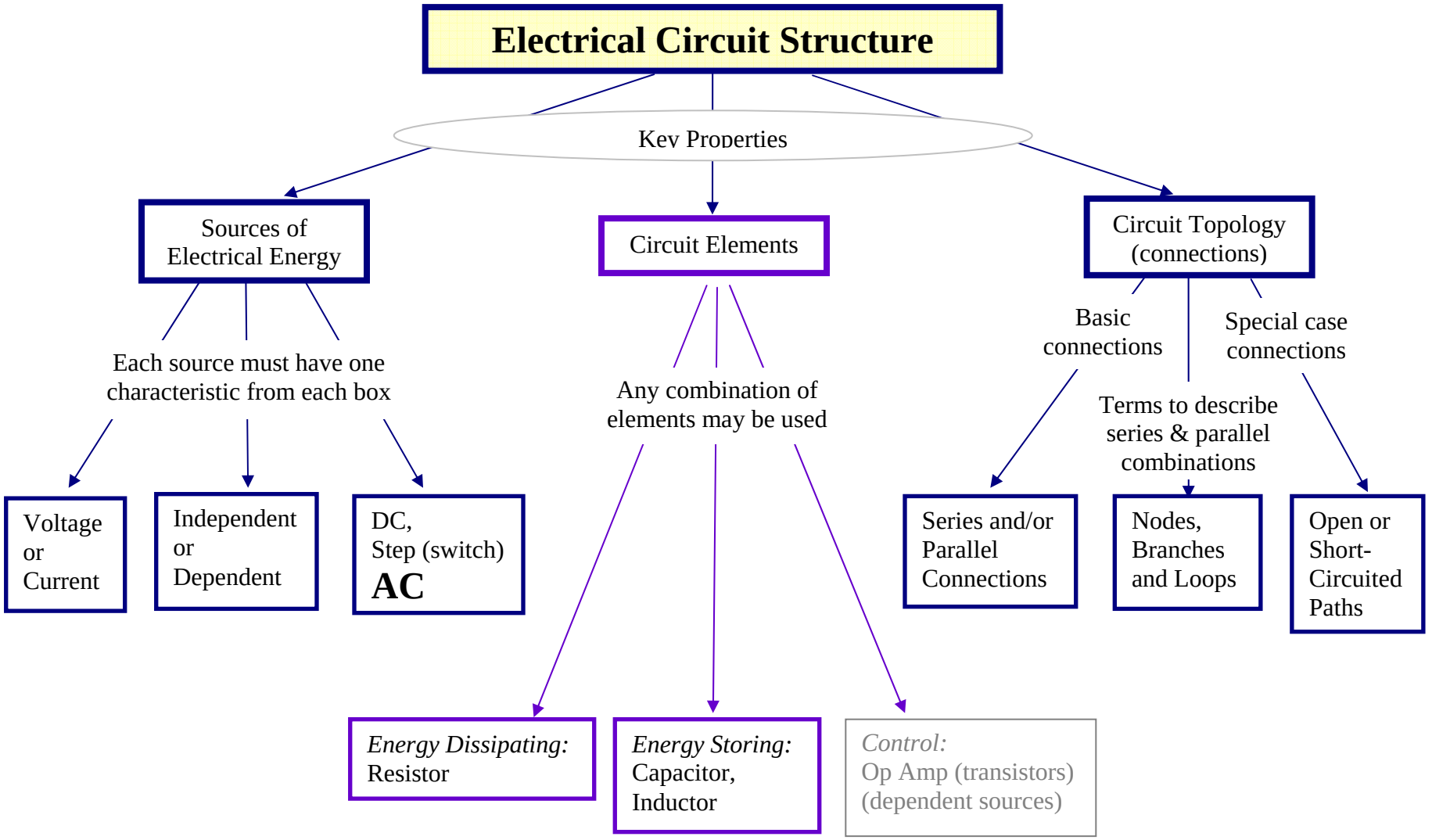
Given your expectations for the circuit behavior, identify the values you need to calculate, select the specific analysis methodology(s) and proceed to calculate the required values.

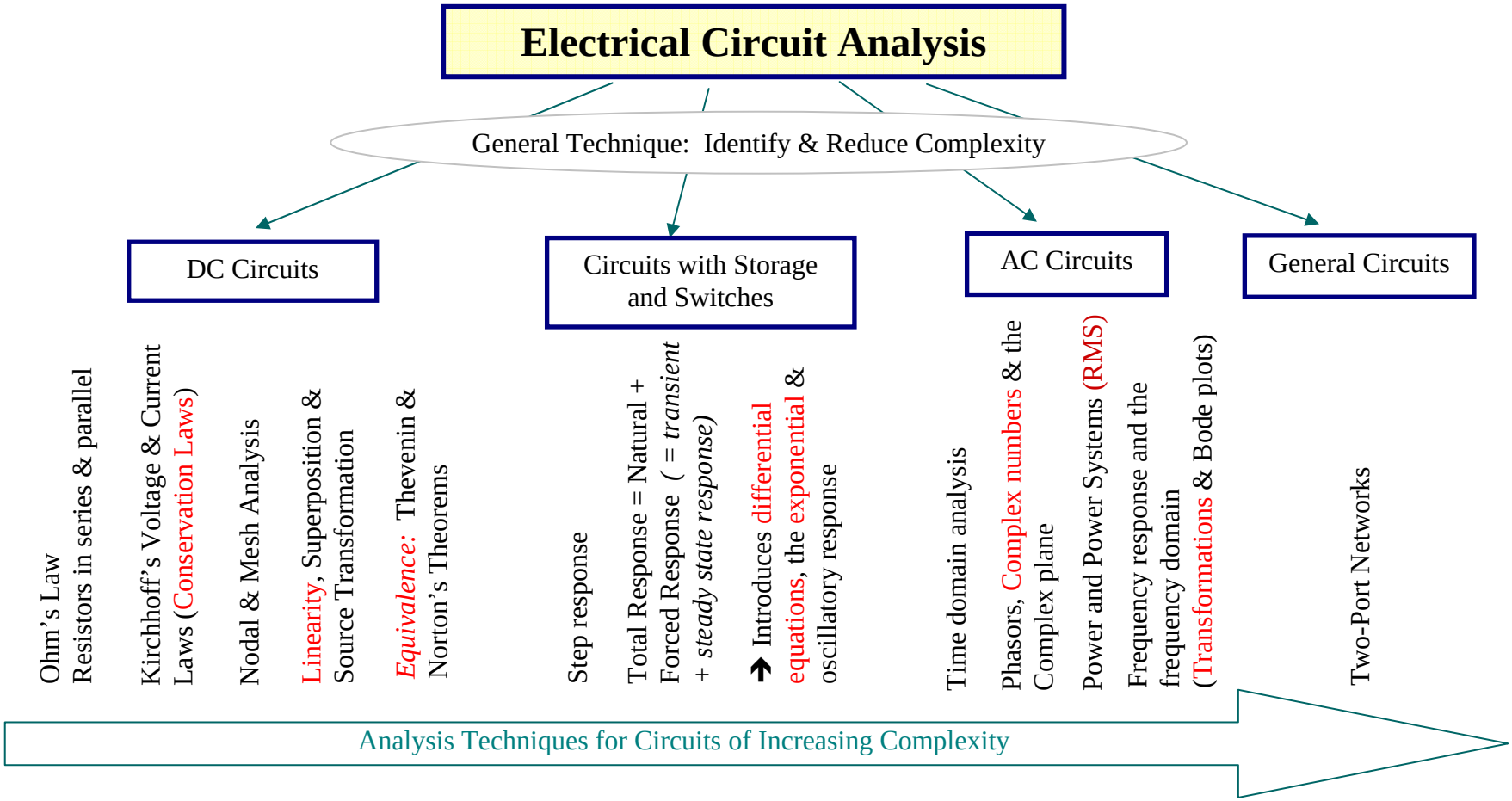
Map 3: Electrical Circuit Analysis

Circuit structure (page 1 below) consists of one or more sources of electrical energy and circuit elements such as resistors, capacitors, inductors and transistors. These elements can be connected in innumerable patterns, typically recognized as series and parallel connections, further identified as branches, nodes and loops.

Circuit behavior (page 2 below) is determined by the sources, elements and topology. Visual inspection of the circuit will guide you, the analyst, in knowing what to expect for the circuit behavior (with practice and experience!)

Throughout EGR 220, you will learn circuit analysis (page 3 below) methodologies that build upon each other, providing you with all the basic tools to analyze any linear electrical circuit. In some situations, more than one methodology is appropriate, while in others there is clearly a best analysis tool.


Electrical Circuit Structure
Key Properties
Sources of Electrical Energy
Circuit Elements
Circuit Topology (connections)
Each source must have one characteristic from each box
Any combination of elements may be used
Basic connections
Special case connections
Terms to describe series & parallel combinations
Voltage or Current
Independent or Dependent
DC, Step (switch) AC
Series and/or Parallel Connections
Nodes, Branches and Loops
Open or Short-Circuited Paths
Energy Dissipating: Resistor
Energy Storing: Capacitor, Inductor
Control: Op Amp (transistors) (dependent sources)



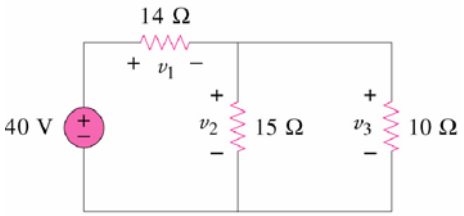
* Red Text indicates key mathematical concepts

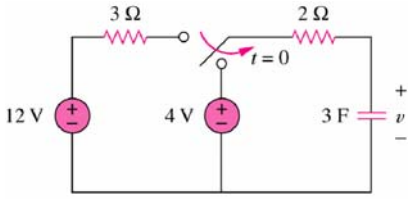
Objective a) Quantify the voltage and current waveforms for every element
b) Quantify the energy and power for each element and the entire circuit

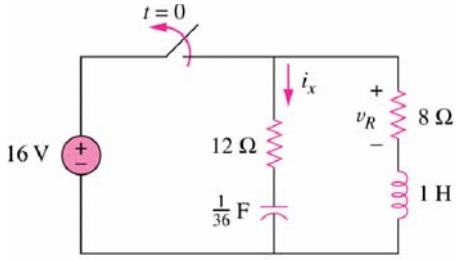
Electrical Circuit Behavior

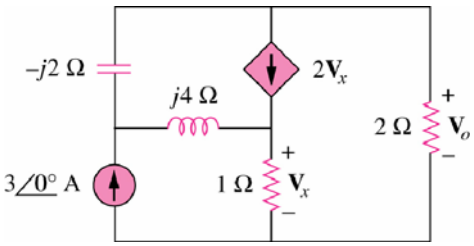
Input, Sources → System, Circuit Composition → Output, Circuit Behavior

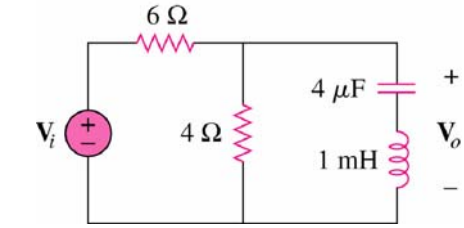
Each circuit below exhibits one of the behaviors on the right.



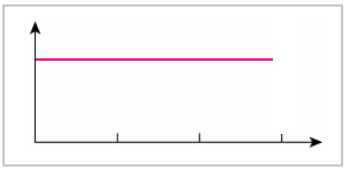


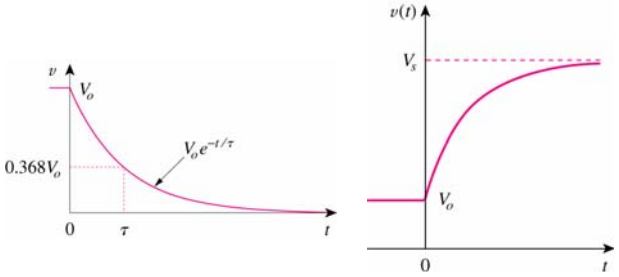


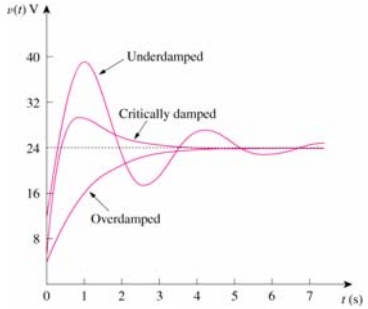


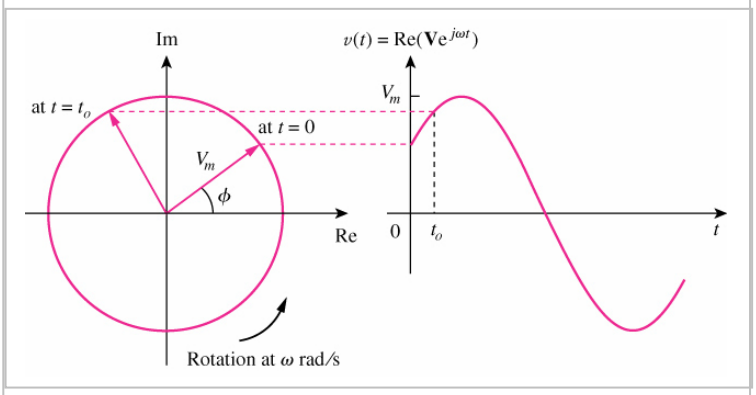


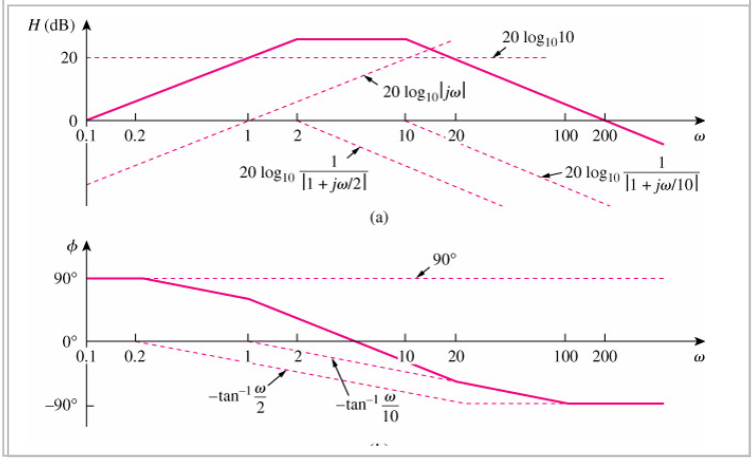
$$H(s) = \frac{200s}{(s+2)(s+10)}$$











DC (static)

First Order Circuit

Second Order Circuit

Phasors: SSS

Multiple *f* input (Bode plot)