Study Guide for Prerequisite Test
Wednesday, Jan 18, 2006
6-7 pm, Room TBA

First – retrieve your EE2110 final and other course papers and notes!

The test will be closed book with only a single sheet (8.5" x 11" maximum) of notes, you can write on both sides. The test will cover steady state dc circuit analysis, power in dc circuits, ac steady state sinusoidal analysis, and power in ac circuits. The questions and problems listed below are intended as a guide to help you study. The fact that something doesn't appear explicitly here doesn't mean you can forget it.

Complex numbers: Be able to convert a complex number between polar and rectangular coordinates (both directions). Be able to add, subtract, multiply, and divide complex numbers.

Phasors: Be able to convert quantities between sinusoidal functions of time and phasors (both directions).

Circuit Theorems: Be able to solve an ac (or dc) circuit using Norton, Thevenin, or the Superposition theorem.

Circuit Analysis:
- Be able to form mesh and node equations. Understand V-I relations for active and passive convention.
- Be able to solve for voltages or currents in a dc circuit consisting of a network of resistors. Pay particular attention to series circuits and parallel circuits.
- Be able to solve for phasor voltages and currents in an ac circuit of a network of resistors, capacitors, and inductors. Pay particular attention to series circuits and to parallel circuits.

Power calculations:
- In a dc circuit, be able to calculate from any two of P, V, I, or R the other two quantities.
- In an ac circuit, be able to calculate from any two of P, Q, S, or θ the other quantities.
- In an ac circuit, be able to calculate from any two of Z, R, X, or θ the other quantities.
- In an ac circuit, be able to calculate from any two of **S**, **V**, and **I** the other quantity.
- In an ac circuit, be able to calculate θ from **V** and **I**

Explanations: Be able to briefly and clearly explain each of the following in your own words: Norton Theorem, Thevenin Theorem, Superposition Theorem, the relationship between a sinusoidal function of time and a phasor, the difference between real, reactive and complex power in an ac circuit, the units for real, reactive, and complex power, the difference between apparent and complex power, current divider, and voltage divider.

In *Fundamental of Electric Circuits* by Alexander and Sadiku review Ch. 9, 10, 11, especially Sec 9.1-9.7, Sec 10.1-10.6 and all of Ch 11
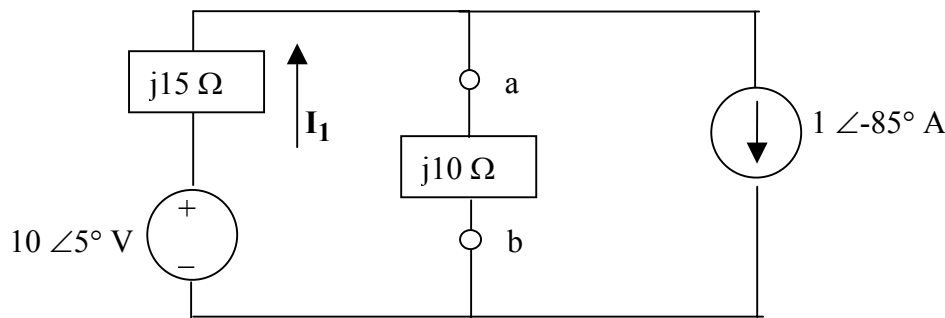
In *Basic Engineering Circuit Analysis* by Irwin review Ch 7 and Ch 9, especially Sec. 7.3 – 7.8, and Sec 9.2-9.6.
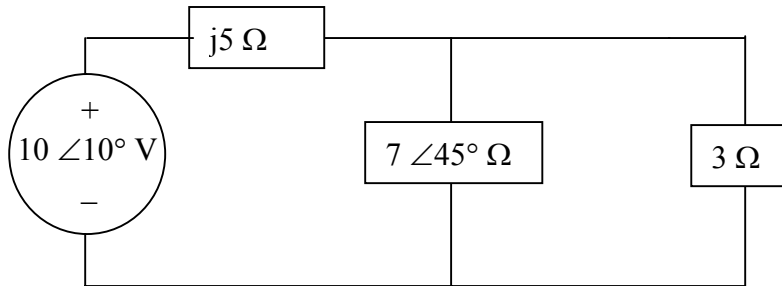
EE 3120 - Prerequisite Test Example Problems

1) Find the Thevenin Equivalent at terminals a-b of the circuit shown below.

j15 Ω

a

1 ∠-85° A

+

10 ∠5° V

−

b
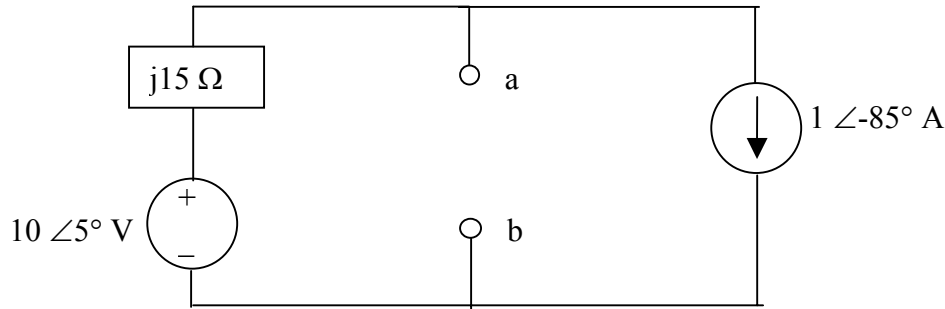
2) Find the current $\mathbf{I_1}$ in the circuit below.

j15 Ω

a

$\mathbf{I_1}$

j10 Ω

1 ∠-85° A

+

10 ∠5° V

−

b

3) Calculate the voltage across the 3 Ω resistor.
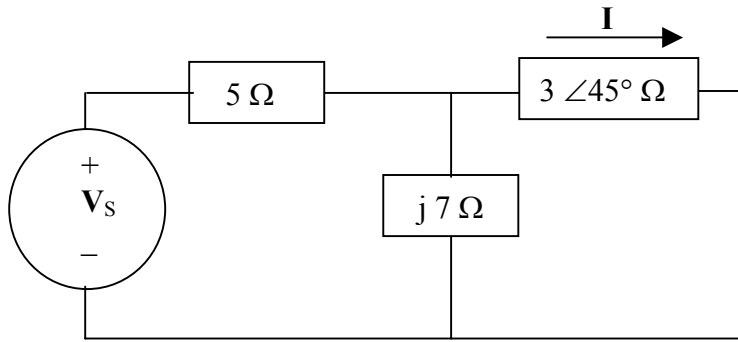
j5 Ω

+

10 ∠10° V

−

7 ∠45° Ω

3 Ω

4) Two loads are connected in parallel. The first load absorbs 5 kVAR at a power factor of 0.8 lagging. The second load absorbs an apparent power of 3 kVA and real power of 2 kW and has a lagging power factor.
   a) What is the complex power that the source supplies to the 2 loads (magnitude and angle)?
   b) The source voltage is 200 ∠0°V. What is the current (magnitude and angle) coming from the source?

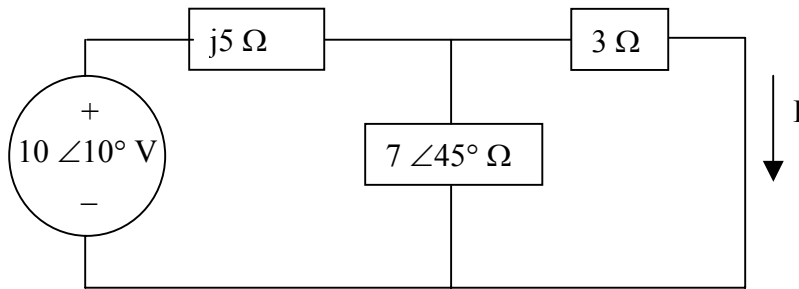5) When a voltage of 100∠10° V is applied across an impedance the complex power absorbed by that impedance is 825∠25° VA.
   a) What is the phasor current drawn by the impedance (magnitude and angle)?
   b) What is the average real power absorbed by the impedance?
   c) What is the reactive power absorbed by the impedance?
   d) Does the impedance appear to be inductive or capacitive at the frequency of the source?
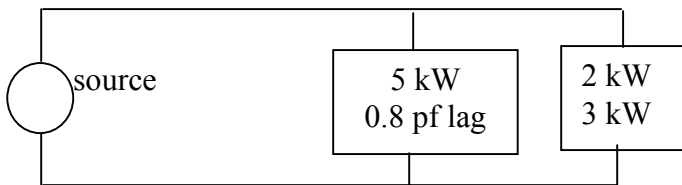
6) The current **I** is 20∠25° A. What is the source voltage **V**$_S$ (magnitude and angle)?

7) Calculate the phasor current **I**.

8) Two loads are connected in parallel (see diagram). The first load absorbs 5 kW at a power factor of 0.8 lagging. The second load absorbs 2 kW and 3 kVAR. What is the complex power that the source supplies to the 2 loads?


9) When a voltage of 100∠10° V is applied across an impedance the current is 5∠55° A.
    e)   What is the complex power absorbed by the impedance? Be sure to include units.
    f)   What is the average real power absorbed by the impedance? Be sure to include units.
    g)   What is the reactive power absorbed by the impedance? Be sure to include units.
    h)   Does the impedance appear to by inductive or capacitive at the frequency of the source?

10) Calculate the current **I**.
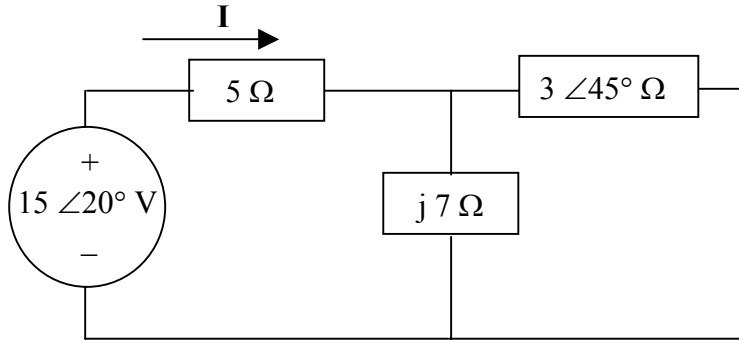
11)   The voltage across an impedance is 250 cos (377t-30°) V. The resulting current through the
      impedance is 5∠30° A (at the same frequency). What is:
  i)   the real power consumed by the load
  ii) the reactive power consumed by the load
  iii) the complex power consumed by the load

12)   The voltage across an impedance is 120∠12° V and the current through the impedance is 10∠-18° A.
      What is the equivalent series resistance and reactance. State whether the reactance is inductive or
      capacitive.

13)   An impedance of 15∠45° Ω is connected across a 120∠0° V source.
  i)   Calculate the current drawn by the load.
  ii) Calculate the complex power absorbed by the load.
  iii) Draw the power triangle for the complex power absorbed by the load. Label the real power, the
       reactive power, the apparent power, and the power angle.
  iv) Calculate the power factor of the load.

14)   Calculate the Thevenin impedance and Thevenin voltage source for the circuit enclosed in the dashed
      line in the circuit below. Sketch the Thevenin equivalent circuit, labeling the impedance and voltage
      source.
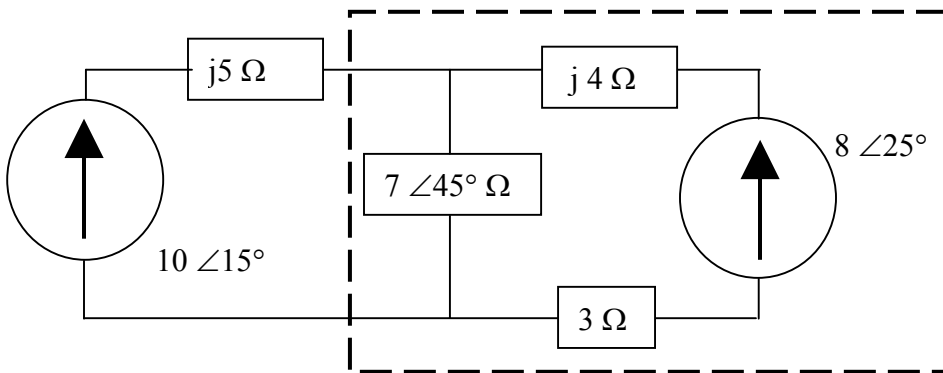
15) For the circuit below, find the voltage V_a (magnitude and angle).

j5 Ω

8∠40° Ω

+

V_a

−

10 ∠15°

+

50 ∠20° V

−
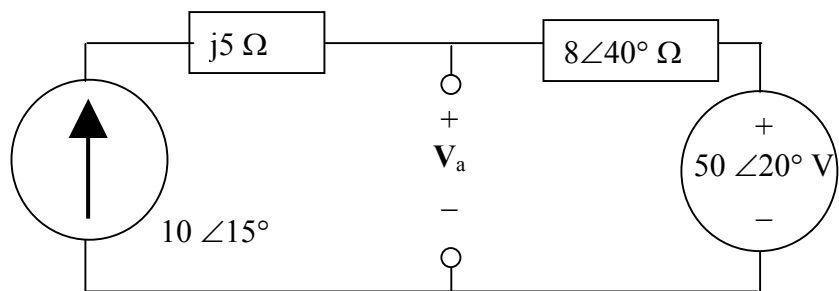
16) For the circuit below calculate the complex power of the voltage source (magnitude and angle). State whether the voltage source is acting as a source or a load.

-j8 Ω

13∠45° Ω

+

50 ∠35° V

−

8 ∠10°

4