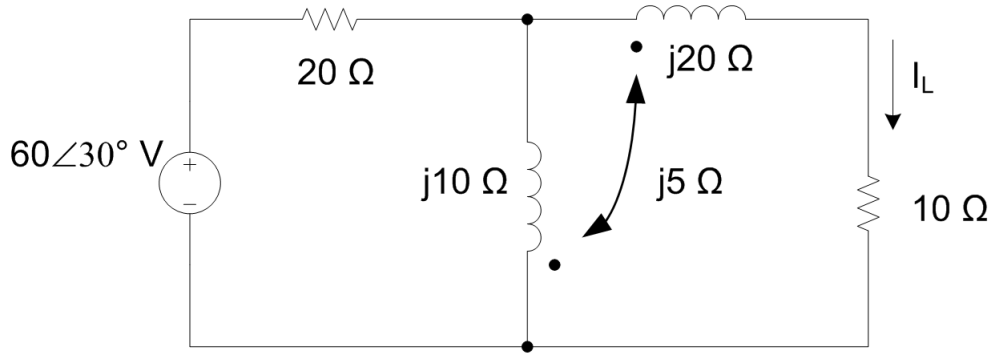
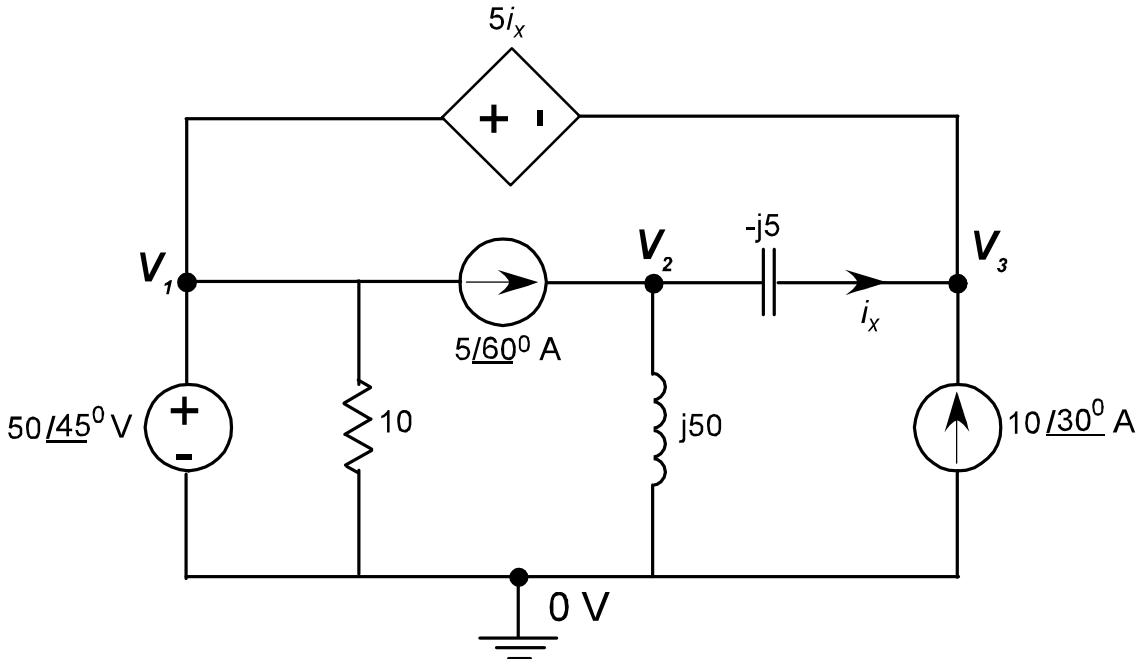
ECE204—AC Circuits
Review for Final Exam w/ answers

1. For the following circuit, find the current I_L in phasor form.



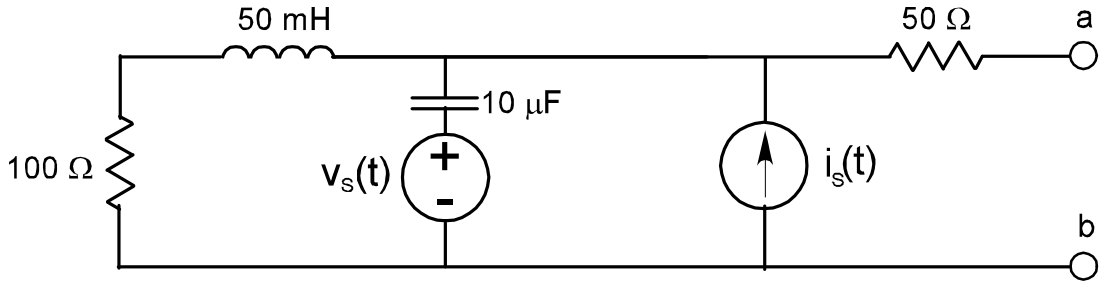
(Ans: I_S =2.74∠17.5°A;I_L =1.00∠31.6°A)

2. Apply nodal analysis to the following circuit and determine the phasor voltages V_1 V_2 and V_3. Confirm your result using mesh analysis.



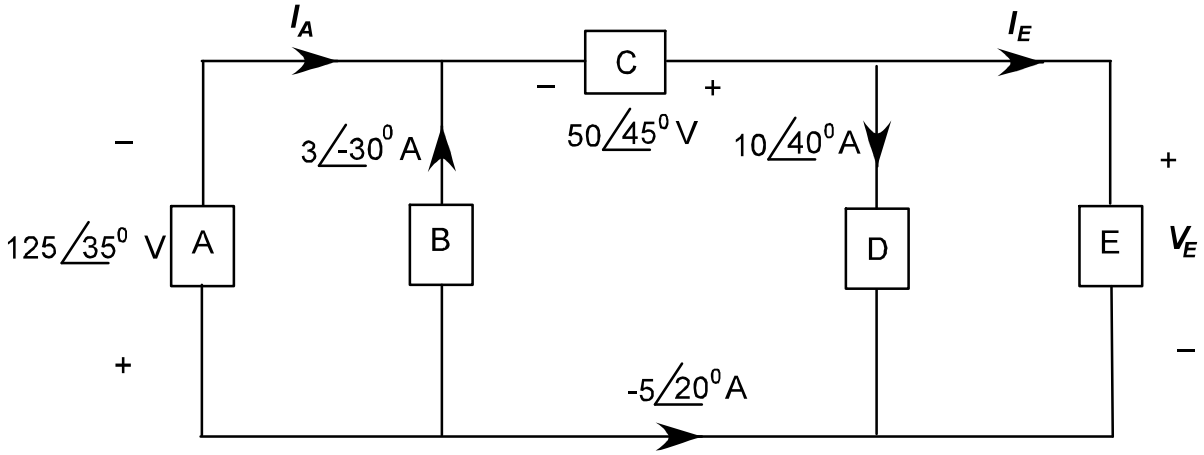
(Ans: V_1=50∠45°V; V_2=49.17∠-4.8°V; V_3=24.11∠21.4°V; I_x=5.9∠64.1°)

3. Determine the Thevenin & Norton Equivalents at terminals a—b. Where the sources are given by:
$v_s(t) = \sqrt{2} \times 500 \cos(2000t + 90^0)$ V and $i_s(t) = \sqrt{2} \times 5 \cos(2000t - 90^0)$ A.



(Ans: V_{TH}=1000∠135°V; I_N=10.8∠175.6°A; Z_{TH}=70-60jΩ)

4. Determine the complex power dissipated by each element and the power factor at each element.



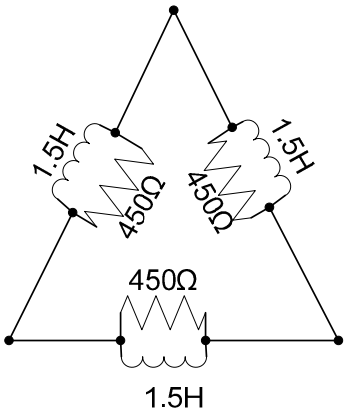
(SA=479.5∠-21.8°VA, SB=375∠65°VA , SC=250∠-155°VA, SD = 762.5∠168.5°VA,SE= 424.8∠-29.4°VA, check that power balances)

5. Three loads A, B & C are supplied at 12.47 kV, 60 Hz, from an ideal three-phase source. Load A is 1.8 MVA at 0.75 lag, load B is 585 kW at 0.9 lead, and load C is three delta-connected 450 Ω/ph resistors in parallel with three 1.5 H/ph inductors. Determine:

a) The complex power drawn from the source

b) The value of capacitance (μF/ph) that has to be placed in parallel with the loads to make the overall power factor 0.925 lag.

ANS: $\mathbf{S_s}$=990.6+j577.4kVA/phase; C = 8.72μF/phase



Three phase delta load

6. A three-phase load is fed from a 60 Hz supply via three parallel feeders each with impedance 0.1 + j0.25 Ω/phase. The load is 9 MVA, 0.864 pf ***lag***. The voltage at the load is 4.16 kV. Determine:

a) Magnitude of the supply voltage (V_S)
b) Percent Voltage Regulation (VR)
c) Real power drawn from the supply
d) Real power lost in the feeder
e) Efficiency of transmission

ANS: $|\mathbf{V_s}|$ = 4.31kV (line-line); VR = 3.7%; η=98%

7. A factory is supplied at 34.5 kV from an ideal 3ϕ, 60 Hz supply. It draws a continuous load of 30 MW with a pf of 0.6 lag. Determine:

a) The capacitance (μF/phase) of a Y-connected bank that will improve the pf to 0.95 lag.
b) The capacitance (μF/phase) if a Δ-connected bank were used.
c) The annual saving in demand charge, if the monthly demand charge is $12.00/kVA.
d) The payback time in months if capacitors cost $90/kVAR to purchase and install and interest is ignored.

ANS: C_Y = 67.2μF; C_Δ = 22.4μF, Savings $2.65 Million; payback = 53 weeks

8. The following data has been acquired from a transformer rated at 15 kVA, 2300/230 V, 60 Hz.

	Voltage	Current	Power
Open-circuit test	Voc = 2300 V	Ioc = 0.21 A	Poc = 50 W
Short-circuit test	Vsc = 47 V	Isc = 6.0 A	Psc = 160 W

a) Find the equivalent circuit impedances and draw the circuit labeling all known values
b) If the transformer is supplying its rated current to a load at 230V and 0.8 pf, lagging, then determine the input voltage of the transformer, the voltage regulation, and the efficiency of the transformer.

ANS: R_c = 106.5 kΩ; X_m = 11.01 kΩ; R = 4.45 Ω; X = 6.45 Ω, V_p = 2348.5 V; VR = 2.1 %, η = 98.03%. (For high voltage side testing)