ECE204—AC Circuits
Review for Test 3 w/ answers

1. A delta-connected three-phase load consists of three 37.5 Ω/ph resistors in parallel with three 132.6 mH/ph inductors. It is connected to a 7.2 kV (line-to-line) supply via a distribution feeder that has an impedance of 0.4 + j0.8 Ω/ph.

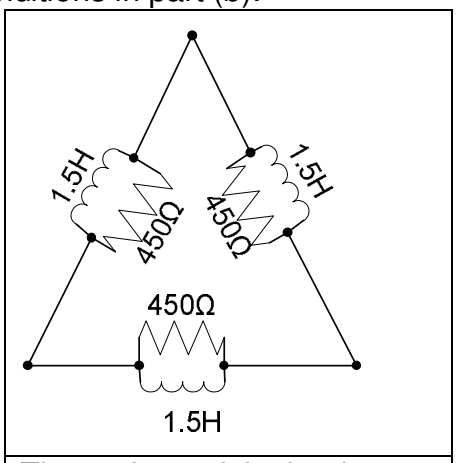
a) Draw the single-phase equivalent circuit.
b) Determine the voltage regulation when the supply voltage is 7.2 kV.
c) Determine the efficiency of transmission for the conditions in part (b).

ANS: VR=8.1%, η=95.2%

2. 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 (shown right). 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

3. 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%

4. If the load in problem 1 was accidently short-circuited, what current would flow out of the source? What is this as a percentage of the current in problem 1? How much real power is drawn out of the source? How much reactive power is drawn out of the source?

ANS: $|\mathbf{I_{out}}|$ = 4.65kA; $\mathbf{S_s}$=8.64+j17.3 MVA/phase

5. 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:

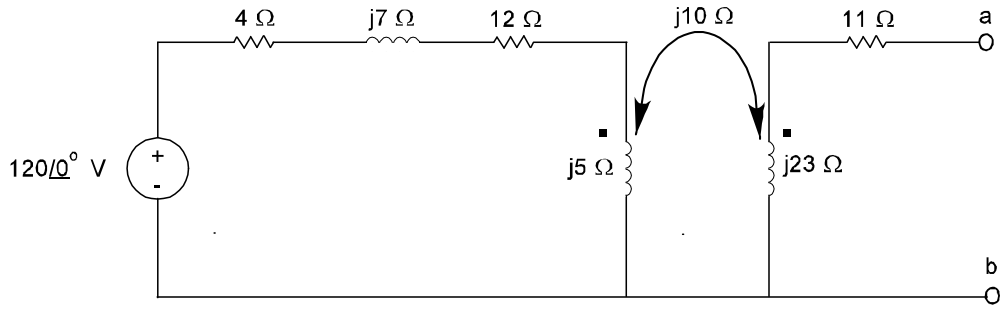
a) The capacitance (μF/phase) of a Y-connected bank that will improve the pf to 0.95 lag.
b) The capacitance (μF/phase) if a Δ-connected bank were used.
c) The annual saving in demand charge, if the monthly demand charge is $12.00/kVA.
d) The payback time in months if capacitors cost $90/kVAR to purchase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

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

6. For the following circuit, determine:

a) the Thevenin equivalent (V_{Th} and Z_{Th}) at a-b

b) the coupling factor (k), if the source frequency is 1 kHz

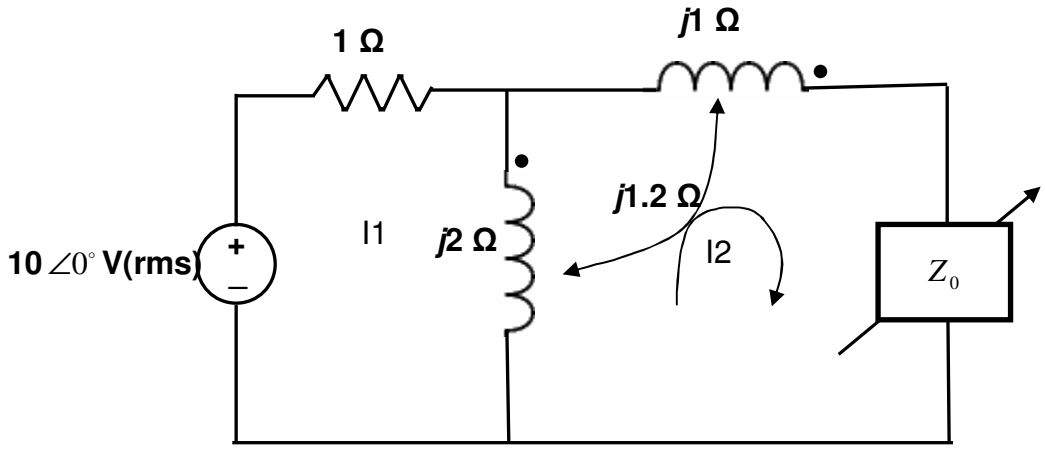


ANS: $V_{Th} = 60\angle 53.1^\circ$ V; $Z_{Th} = 25\angle 53.1^\circ\Omega = 15+j20\Omega$, k=0.9325.

7. For the following circuit determine:

a) the impedance of Z_0 which causes the maximum average power transfer to Z_0.

b) the maximum average power delivered to Z_0

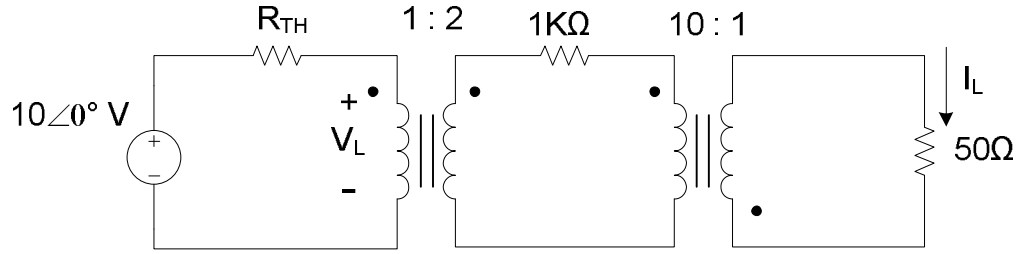


ANS: $Z_{Th} = 2.048+j1.304\Omega$, $P_{max}=25$W.

8. For the following circuit,

a) Find R_{TH} such that $V_L = 5\angle 0°$ V

b) use R_{TH} from **part a** and $V_L = 5\angle 0°$ V to find the current I_L in phasor form.



ANS: $R_{Th} = 1500\Omega$, I_L= -50/3 mA.