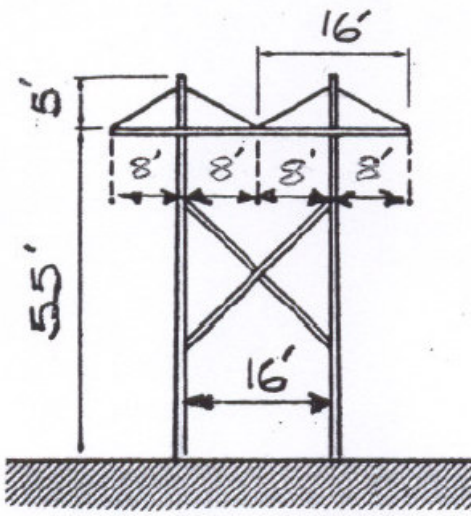
ECE470 POWER SYSTEMS I

Homework Set 6

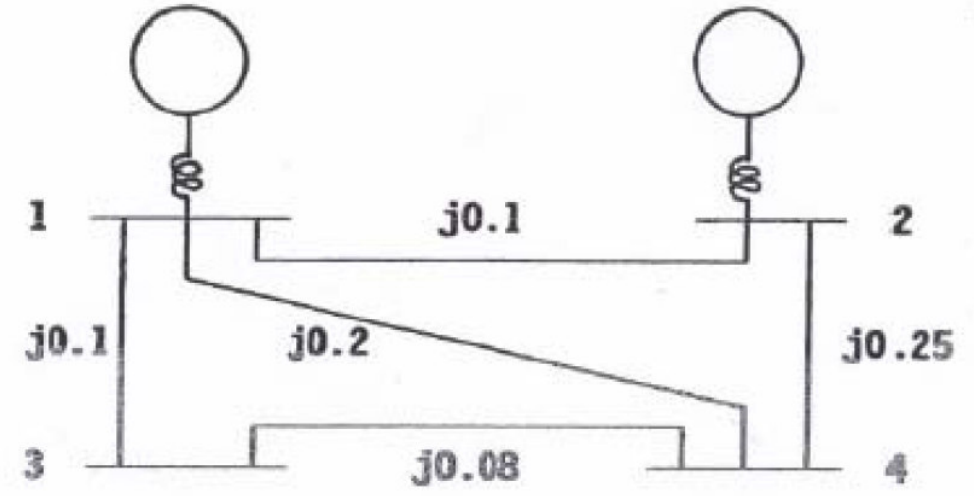
1. The phases of the 115 kV, wood H-frame line shown below are suspended from 7 insulator bells. The footing resistance has been measured and is close to 15 ohm at each structure. Lightning characteristics are as shown in the course notes. If the line is 40 miles long and runs through an area with a keraunic level of 45 days/yr, estimate the number of lightning-induced outages per year. What would be the % improvement if an extra insulator was added to each string?



2. The impedances in the system below are in pu on a base of 200 MVA, 115 kV. Both generators have 0.5 pu synchronous reactance. Ignoring the effect of any loads:

a) derive the $[Y_{bus}]$ matrix of the system, and

b) invert it to produce $[Z_{bus}]$.

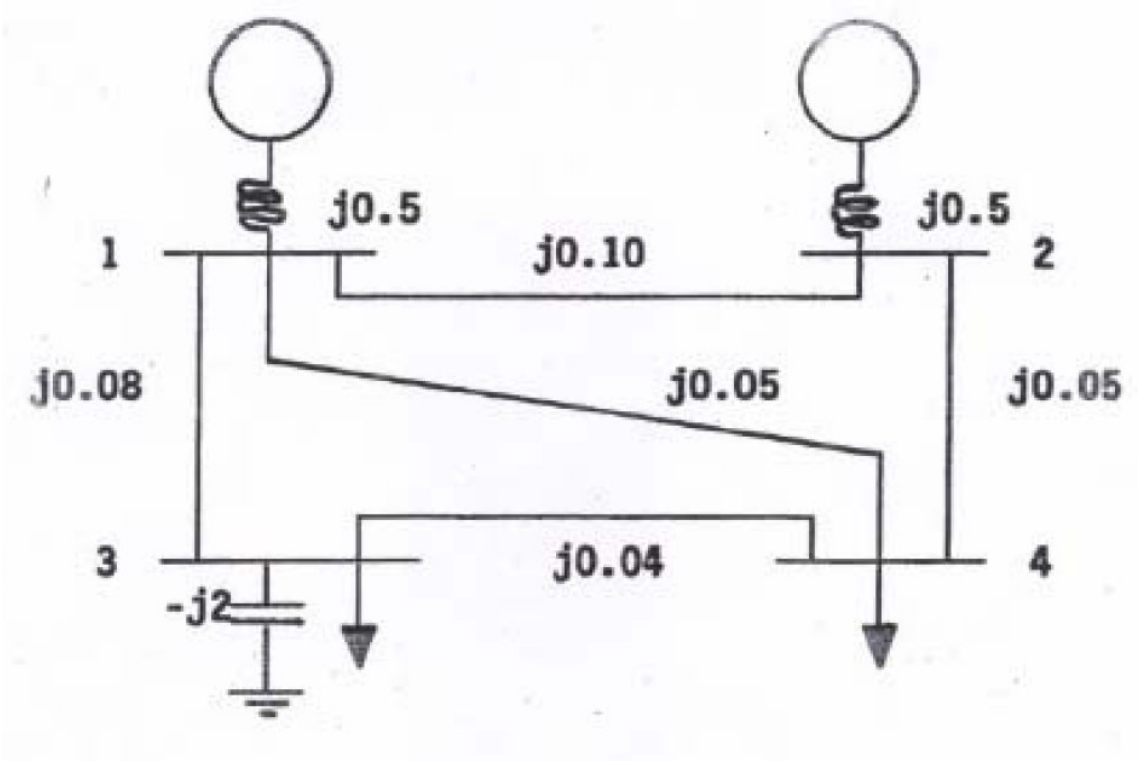


3. The impedances In the system below are in pu on a base of 100 MVA, 230 kV, both loads are rated at S = 0.5 pu, zpf (i.e., they are 0.5 pu when their voltages are 1 pu). The excitation voltage at generator 1 is 276 kV and a t generator 2 it is 253 kV. Both generators have 0.5 pu synchronous reactance as shown.

a) Derive the $[Y_{bus}]$ matrix of the system.

b) Determine all bus voltages (kV).

c) Remove the capacitor bank at bus 3 and repeat part (b).



4. A 18 kV, 60 Hz, 150 MVA, Y-connected, ten pole, salient-pole generator supplies rated load at 0.8 lag pf and rated voltage. Neglect armature resistance, $X_d = 3.5\ \Omega$ and $X_q = 2\ \Omega$. Determine:

a) E_f and δ.

b) Real and reactive power developed.

c) Driving torque if the rotational losses are 8 MW.