Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science
6.691 Seminar in Advanced Electric Power Systems

Problem Set 2

Issued February 26, 2006
Due March 15, 2006

This problem set involves the example power system which was presented in class on class on February 20, reproduced in Figure 1. We are going to do a few things with this example system, so save your notes.

1. Re-draw the system diagram with all impedances and loads translated to per-unit. Assume that the transformers between 69 and 161 kV buses 15 and 16 at one substation and between buses 9 and 17 at another substation are rated at 150 MVA and that their voltage ratings correspond with the nominal system voltages. You may represent them as purely reactive with $x_t = 8\%$ on their own base. For your per-unit normalization use a system base of 100 MVA and the nominal system voltages (161 and 69 kV). Note, of course, that power called out at each bus is MW+j*MVAR and that voltages are line-line, RMS.

2. Find a 'load flow' solution which includes bus voltages (magnitudes and angles) and line flows. Assume the power plants connected to buses 2 and 3 are producing 220 MW and 70 MVAR (each). Assume that the power plant connected to Bus 1 is providing whatever real and reactive power is required to maintain the system at constant frequency and the voltage at Bus 1 at rated (161 kV). As we will discuss in class, there are multiple ways of computing this load flow. I would suggest doing the calculation using both Gauss-Seidel and Newton-Raphson and comparing the solutions.
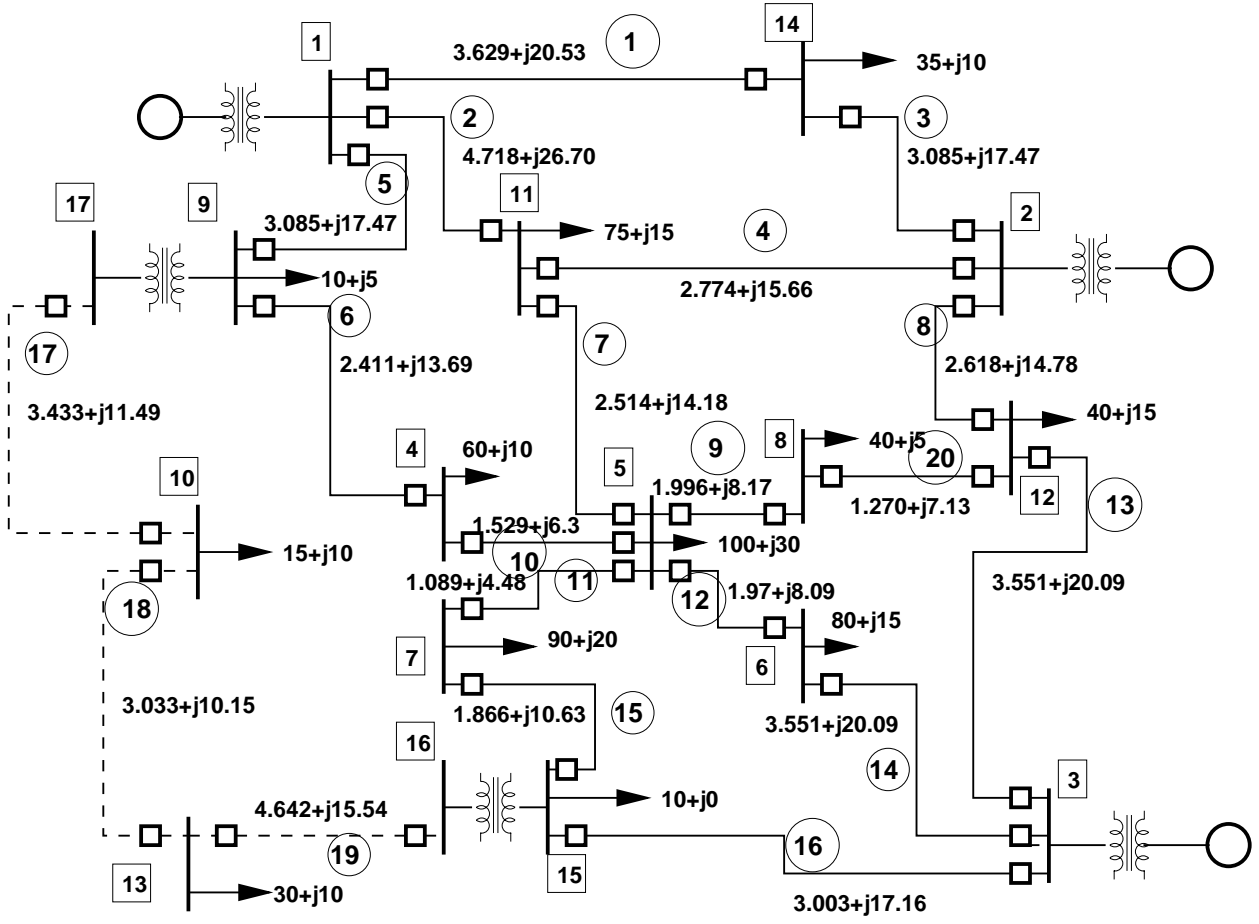
Figure 1: Example Power System