ECE470 POWER SYSTEMS I

Homework Set 7

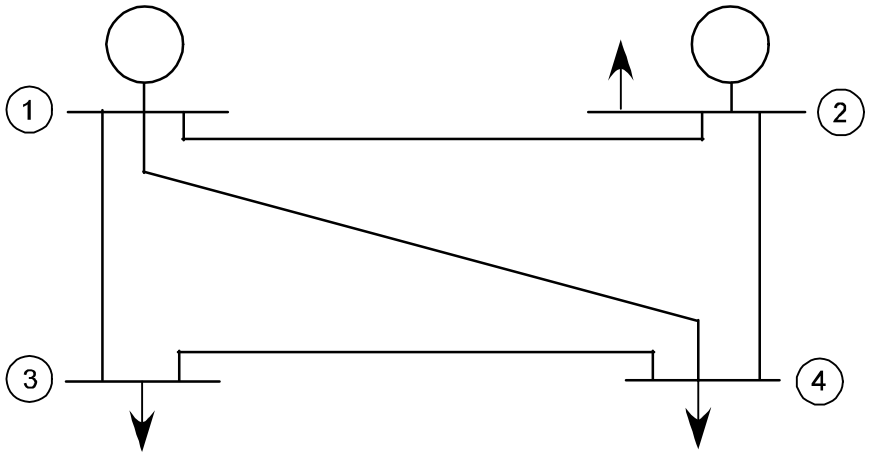
Complete the Load Flow lab work, plus the following questions.

1.

a) Load Flow analysis was performed on the system shown below and the results are presented in tables 1 & 2. Determine:
   - i) the current (A or kA) received at bus 3 from bus 4,
   - ii) the current (A or kA) flowing out of generator 2, and
   - iii) the power factor of generator 1.

b) Another load flow was run with one line removed for maintenance; the results are shown in table 3. If losses cost $80/MWh and the outage lasts for ten weeks, how much is the increase in losses costing the utility? (Assume the loads are constant).

c) It was decided to install capacitors at bus 4 during the outage. The results of a load flow are shown in table 4. Determine:
   - i) The MVAR rating of the capacitor bank.
   - ii) The capacitance/phase for wye-connected capacitors.
   - iii) The saving in cost of losses achieved by installing the capacitors for the outage period.



$V_B = 500\ kV$

$S_B = 500\ MVA$

Table 1

BUS#	MAG pu	ANGLE degrees	PG pu	QG pu	PL pu	QL pu
1	1.050	0.000	2.050	1.950	0.400	0.300
2	1.050	2.040	1.500	0.550	1.200	0.800
3	0.985	- 2.213	0.000	0.000	1.000	0.600
4	0.975	- 3.141	0.000	0.000	0.800	0.500
		TOTAL	3.550	2.500	3.400	2.200

Table 2

LINE #	BUS TO BUS		P	Q	S
1	1	2	0.797	1.047	1.316
	2	1	-0.705	-0.636	0.950
2	1	3	0.695	0.892	1.131
	3	1	-0.601	-0.219	0.640
3	1	4	0.554	0.014	0.554
	4	1	-0.334	0.080	0.343
4	2	4	1.005	0.386	1.077
	4	2	-0.761	-0.865	1.152
5	3	4	-0.399	-0.381	0.552
	4	3	0.295	0.285	0.410

Table 3

BUS#	MAG pu	ANGLE degrees	PG pu	QG pu	PL pu	QL pu
1	1.050	0.000	2.180	1.823	0.400	0.300
2	1.050	-4.797	1.500	0.880	1.200	0.800
3	0.933	-8.945	0.000	0.000	1.000	0.600
4	0.953	-6.193	0.000	0.000	0.800	0.500
		TOTAL	3.680	2.703	3.400	2.200

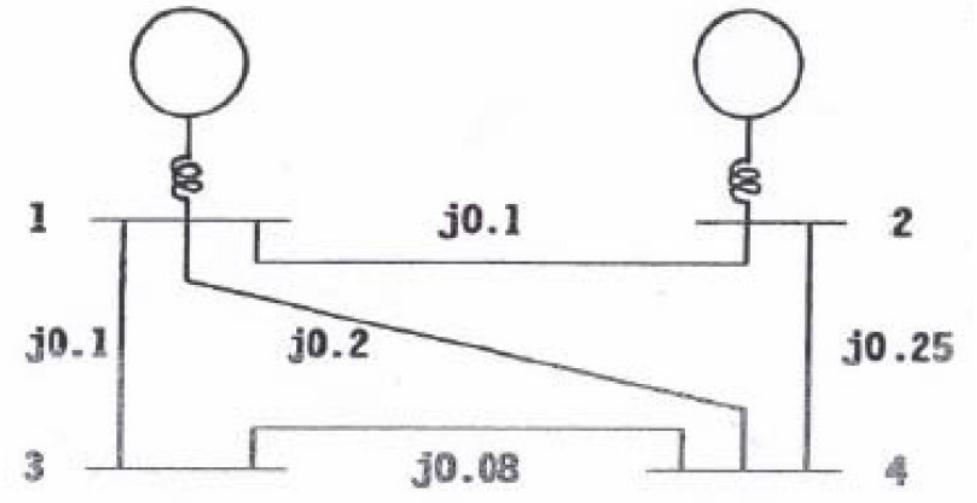
Table 4

BUS#	MAG pu	ANGLE degrees	PG pu	QG pu	PL pu	QL pu
1	1.050	0.000	2.000	1.770	0.400	0.300
2	1.050	-3.775	1.500	0.670	1.200	0.800
3	0.964	-13.073	0.000	0.000	1.000	0.600
4	0.980	-16.862	0.000	0.311	0.800	0.500
		TOTAL	3.500	2.751	3.400	2.200

2. The impedances in the system below are in pu on a base of 200 MVA, 115 kV. Both generators have 0.5 pu sub-transient reactance. Ignoring the effect of any loads, use the $[Y_{bus}]$ matrix derived in last week's HW to determine:

a) the nominal balanced 3ϕ fault level at each bus, and

b) the current flowing from bus 1 to bus 4 when bus 4 is faulted.



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 at generator 2 it is 253 kV. Both generators have 0.5 pu synchronous reactance as shown. Ignoring the effect of any loads:

a) use the $[Y_{bus}]$ matrix derived in last week's HW to determine the nominal balanced 3ϕ fault level at bus 3 and the currents flowing from busses 1 and 4; and

b) remove the capacitor bank at bus 3 and repeat part (a).