ELEC4505 Power System Analysis

Assignment one — Power Flow Analysis

Deadline: 23:59PM AWST, the 17th April 2025.
Weight: 15%

Given the 16-generator power system information (see appendix A~D in page 2 to page 5), please find/analyse:

1. Admittance matrix of the power system.
2. Power flow with Gauss-Seidel method.
3. Power flow with Newton-Raphson method.
4. Total loss and overall power efficiency; and
5. Change generator data and try to reduce the total loss, thus increasing the power efficiency.

Notes:

a. Refer to MATPOWER manual at http://www.pserc.cornell.edu/matpower/manual.pdf for functions that have not been included in class notes.
b. For item 1, use MATPOWER to find the admittance matrix of the 16-generator power system. Then write a MATLAB script to calculate the admittance matrix of the 16-generator power system. Compare and analyse the admittance matrixes generated from the MATPOWER and MATLAB script. Use spreadsheets to store the values of admittance matrixes. Submit spreadsheets and all scripts along with your assignment report.
c. For items 2 & 3. Simulate the power system in MATPOWER, solve power flow using these two methods, collect simulation data and conduct result analysis. Finally, compare and document the simulation results obtained from both methods.
d. For item 5, try at least 20 different generation capacities of different generators. Tabulate your simulation results and report the loss and efficiency for each generation capacity.
e. For all items, you must review the background knowledge, describe your approach, document the simulation and/or calculation results, and conduct a result analysis in your group report. All MATPOWER and MATLAB scripts used to generate results must be fully commented and submitted along with your report. Please note that a "readme.txt" file is essential for the marker to understand how to execute your scripts and codes.
f. Refer to “Assignment 1 FAQ” section under “Assignment One” folder on LMS for more information.

Purpose of the assignment:

(1) Review the basics of power flow fundamentals,
(2) Understand power system components and configurations,
(3) Get familiarized with MATLAB coding environment, and
(4) Develop skills and comprehensions of the steady-state analysis tool—MATPOWER.

Submission:

(1) Each group is required to write a concise and clear report in English and submit it online via LMS before the due date. Hardcopy submissions are not required.
(2) The contributions of each individual student must be clearly indicated in front of the report. A complete and signed assignment coversheet must be attached to the group submission.

(3) The report should not exceed 15 pages, and your answers should be neat, clear, and easy to read.
(4) Use EMS-PP-Report-Template-V3.rtf as a template for your group report. Only include the content that is applicable to your work.
(5) Submit the team report (and other necessary files) on LMS before the due time. The submission link is available under the "Group Assignments" section of your group page on LMS. You are allowed to submit up to three versions, but only the final attempt will be marked. If your team submits the final version report after the due time, it will be assessed as a late submission.

APPENDIX A: The topology of 16 generator power system is shown in the following schematic:

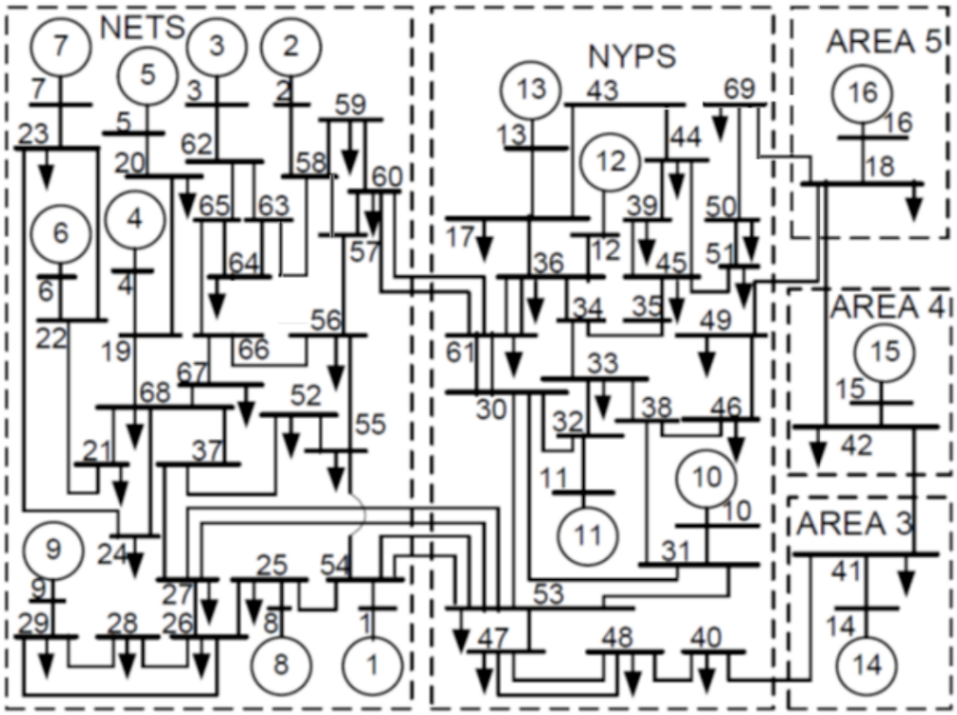

Fig. 1- 16-machine, 5-area test system topology

APPENDIX B: The machine data is shown below (base: 100MVA)

Bus number	*Voltage (pu)*	Power generation (pu)
1	1.0450	2.50
2	0.9800	5.45
3	0.9830	6.50
4	0.9970	6.32
5	1.0110	5.05
6	1.0500	7.00
7	1.0630	5.60
8	1.0300	5.40
9	1.0250	8.00
10	1.0100	5.00
11	1.0000	10.00
12	1.0156	13.50
13	1.0110	35.91
14	1.0000	17.85
15	1.0000	10.00
16	1.0000	40.00

APPENDIX C: Load data is shown below (base: 100MVA)

Bus number	*Real load (pu)*	*Reactive load (pu)*
17	60.00	3.0000
18	24.70	1.2300
19	0	0
20	6.80	1.0300
21	2.74	1.1500
22	0	0
23	2.48	0.8500
24	3.09	-0.9200
25	2.24	0.4700
26	1.39	0.1700
27	2.81	0.7600
28	2.06	0.2800
29	2.84	0.2700
30	0	0
31	0	0
32	0	0
33	1.12	0
34	0	0
35	0	0
36	1.02	-0.1946
37	0	0
38	0	0
39	2.67	0.1260
40	0.6563	0.2353
41	10.00	2.5000
42	11.50	2.5000
43	0	0
44	2.6755	0.0484
45	2.08	0.2100
46	1.507	0.2850
47	2.0312	0.3259
48	2.412	0.0220
49	1.64	0.2900
50	1.00	-1.4700
51	3.37	-1.2200
52	1.58	0.3000
53	2.527	1.1856
54	0	0
55	3.22	0.0200
56	2.00	0.7360
57	0	0
58	0	0
59	2.34	0.8400
60	2.088	0.7080
61	1.04	1.2500
62	0	0
63	0	0
64	0.09	0.8800
65	0	0
66	0	0
67	3.20	1.5300
68	3.29	0.3200
69	0	0

APPENDIX D: Power system transmission line data is shown in the following table

From Bus	*To Bus*	*Resistance (pu)*	*Reactance (pu)*	*Line charging (pu)*	*Tap ratio*
54	1	0	0.0181	0	1.0250
58	2	0	0.0250	0	1.0700
62	3	0	0.0200	0	1.0700
19	4	0.0007	0.0142	0	1.0700
20	5	0.0009	0.0180	0	1.0090
22	6	0	0.0143	0	1.0250
23	7	0.0005	0.0272	0	0
25	8	0.0006	0.0232	0	1.0250
29	9	0.0008	0.0156	0	1.0250
31	10	0	0.0260	0	1.0400
32	11	0	0.0130	0	1.0400
36	12	0	0.0075	0	1.0400
17	13	0	0.0033	0	1.0400
41	14	0	0.0015	0	1.0000
42	15	0	0.0015	0	1.0000
18	16	0	0.0030	0	1.0000
36	17	0.0005	0.0045	0.3200	0
49	18	0.0076	0.1141	1.1600	0
68	19	0.0016	0.0195	0.3040	0
19	20	0.0007	0.0138	0	1.0600
68	21	0.0008	0.0135	0.2548	0
21	22	0.0008	0.0140	0.2565	0
22	23	0.0006	0.0096	0.1846	0
23	24	0.0022	0.0350	0.3610	0
68	24	0.0003	0.0059	0.0680	0
54	25	0.0070	0.0086	0.1460	0
25	26	0.0032	0.0323	0.5310	0
37	27	0.0013	0.0173	0.3216	0
26	27	0.0014	0.0147	0.2396	0
26	28	0.0043	0.0474	0.7802	0
26	29	0.0057	0.0625	1.0290	0
28	29	0.0014	0.0151	0.2490	0
53	30	0.0008	0.0074	0.4800	0
61	30	0.0019	0.0183	0.2900	0
61	30	0.0019	0.0183	0.2900	0
30	31	0.0013	0.0187	0.3330	0
53	31	0.0016	0.0163	0.2500	0
30	32	0.0024	0.0288	0.4880	0
32	33	0.0008	0.0099	0.1680	0
33	34	0.0011	0.0157	0.2020	0
35	34	0.0001	0.0074	0	0.9460
34	36	0.0033	0.0111	1.4500	0
61	36	0.0022	0.0196	0.3400	0
61	36	0.0022	0.0196	0.3400	0
68	37	0.0007	0.0089	0.1342	0
31	38	0.0011	0.0147	0.2470	0
33	38	0.0036	0.0444	0.6930	0
41	40	0.0060	0.0840	3.1500	0
48	40	0.0020	0.0220	1.2800	0
42	41	0.0040	0.0600	2.2500	0
18	42	0.0040	0.0600	2.2500	0
17	43	0.0005	0.0276	0	0
39	44	0	0.0411	0	0
43	44	0.0001	0.0011	0	0
35	45	0.0007	0.0175	1.3900	0
39	45	0	0.0839	0	0
44	45	0.0025	0.0730	0	0
38	46	0.0022	0.0284	0.4300	0
53	47	0.0013	0.0188	1.3100	0
47	48	0.0025	0.0268	0.4000	0
47	48	0.0025	0.0268	0.4000	0
46	49	0.0018	0.0274	0.2700	0
45	51	0.0004	0.0105	0.7200	0

50	51	0.0009	0.0221	1.6200	0
37	52	0.0007	0.0082	0.1319	0
55	52	0.0011	0.0133	0.2138	0
53	54	0.0035	0.0411	0.6987	0
54	55	0.0013	0.0151	0.2572	0
55	56	0.0013	0.0213	0.2214	0
56	57	0.0008	0.0128	0.1342	0
57	58	0.0002	0.0026	0.0434	0
58	59	0.0006	0.0092	0.1130	0
57	60	0.0008	0.0112	0.1476	0
59	60	0.0004	0.0046	0.0780	0
60	61	0.0023	0.0363	0.3804	0
58	63	0.0007	0.0082	0.1389	0
62	63	0.0004	0.0043	0.0729	0
64	63	0.0016	0.0435	0	1.0600
62	65	0.0004	0.0043	0.0729	0
64	65	0.0016	0.0435	0	1.0600
56	66	0.0008	0.0129	0.1382	0
65	66	0.0009	0.0101	0.1723	0
66	67	0.0018	0.0217	0.3660	0
67	68	0.0009	0.0094	0.1710	0
53	27	0.0320	0.3200	0.4100	1.0000
69	18	0.0006	0.0144	1.0300	0
50	69	0.0006	0.0144	1.0300	0