Appendix I: Data for Test Systems CASE13, CASE25, CASE37, and CASE28

Table I.1: General Data of CASE13

General Data	
Slack	1
Vnom (kV)	4.16
InternationalSystem	0
DeltaLF	0
V_slack_ph_A	1.000
V_slack_ph_B	1.000
V_slack_ph_C	1.000
Ang_slack_ph_A	0
Ang_slack_ph_B	-120
Ang_slack_ph_C	120

Table I.2: Topology of CASE13

Node A	**Node B**	**Length (ft.)**	**Config.**
1	4	500	3
1	2	500	2
4	5	300	3
10	6	800	7
1	7	2000	1
7	10	300	4
7	9	1000	1
10	3	300	5
7	8	500	6

Table I.3: Line Parameter of CASE13

Config	R11	R12	R13	R22	R23	R33
1	0.3465	0.156	0.158	0.3375	0.1535	0.3414
2	0.7526	0.158	0.156	0.7475	0.1535	0.7436
3	–	0	0	1.3294	0.2066	1.3238
4	1.3238	0	0.2066	–	0	1.3294
5	–	0	0	–	0	1.3292
6	0.7982	0.3192	0.2849	0.7891	0.3192	0.7982
7	1.3425	0	0	–	0	–
Config	X11	X12	X13	X22	X23	X33
1	1.0179	0.5017	0.4236	1.0478	0.3849	1.0348
2	1.1814	0.4236	0.5017	1.1983	0.3849	1.2112
3	0	0	0	1.3471	0.4591	1.3569
4	1.3569	0	0.4591	0	0	1.3471
5	0	0	0	0	0	1.3475
6	0.4463	0.0328	-0.0143	0.4041	0.0328	0.4463
7	0.5124	0	0	0	0	0
Config	B11	B12	B13	B22	B23	B33
1	6.2998	-1.9958	-1.2595	5.9597	-0.7417	5.6386
2	5.699	-1.0817	-1.6905	5.1795	-0.6588	5.4246
3	0	0	0	4.7097	-0.8999	4.6658
4	4.6658	0	-0.8999	0	0	4.7097
5	0	0	0	0	0	4.5193
6	96.8897	0	0	96.8897	0	96.8897
7	88.9912	0	0	0	0	0

Table I.4: Load Data of CASE13

Bus	Phase-a		Phase-b		Phase-c	
	KW	KVAr	KW	KVAr	KW	KVAr
2	160	110	120	90	120	90
4	0	0	170	125	0	0
5	0	0	230	132	0	0
6	128	86	0	0	0	0
7	402	230	451	258	672	439
8	485	-10	68	-140	290	12
3	0	0	0	0	170	-20

Table I.5: Load Data of ill-conditioned CASE13

Bus	Phase-a		Phase-b		Phase-c	
	KW	KVAr	KW	KVAr	KW	KVAr
2	1600	1100	1200	900	1200	900
4	0	0	1700	1250	0	0
5	0	0	2300	1320	0	0
6	1280	860	0	0	0	0
7	4886	2795	5481	3136	8007	5335
8	4850	-100	680	-140	2900	120
3	0	0	0	0	1700	-20

Table I.6: General Data of CASE25

General Data	
Slack	1
Vnom (kV)	4.16
International System	0
DeltaLF	0
V_slack_ph_A	1
V_slack_ph_B	1
V_slack_ph_C	1
Ang_slack_ph_A	0
Ang_slack_ph_B	-120
Ang_slack_ph_C	120

Table I.7: Topology of CASE25

Node A	Node B	Length (ft.)	Config.
1	2	1000	1
2	3	500	1
2	6	500	2
3	4	500	1
3	18	500	2
4	5	500	2
4	23	400	2
6	7	500	2
6	8	1000	2
7	9	500	2
7	14	500	2
7	16	500	2
9	10	500	2
10	11	300	2
11	12	200	3
11	13	200	3
14	15	300	2
14	17	300	3
18	20	500	2
18	21	400	3
20	19	400	3
21	22	400	3
23	24	400	2
24	25	400	3

Table I.8: Line Parameters of CASE25

Conf	R11	R12	R13	R22	R23	R33
1	0.3686	0.0169	0.0155	0.3757	0.0188	0.3723
2	0.9775	0.0167	0.0152	0.9844	0.0186	0.981
3	1.928	0.0161	0.0161	1.9308	0.0161	1.9337
Conf	X11	X12	X13	X22	X23	X33
1	0.6852	0.1515	0.1098	0.6715	0.2072	0.6782
2	0.8717	0.1697	0.1264	0.8654	0.2275	0.8648
3	1.4194	0.1183	0.1183	1.4215	0.1183	1.4236
Conf	B11	B12	B13	B22	B23	B33
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0

Table I.9: Load Data of CASE25

Bus	Ph-1 (kW)	Ph-1 (kVAr)	Ph-2 (kW)	Ph-2 (kWAr)	Ph-3 (KW)	Ph-3 (kVAr)
2	0	0	0	0	0	0
3	35	25	40	30	45	32
6	40	30	45	32	35	25
4	50	40	60	45	50	35
18	40	30	40	30	40	30
5	40	30	40	30	40	30
23	60	45	50	40	50	35
7	0	0	0	0	0	0
8	40	30	40	30	40	30
9	60	45	50	40	50	35
14	50	35	50	40	60	45
16	40	30	40	30	40	30
10	35	25	40	30	45	32
11	45	32	35	25	40	30
12	50	35	60	45	50	40
13	35	25	45	32	40	30
15	133.3	100	133.3	100	133.3	100
17	40	30	35	25	45	32
20	35	25	40	30	45	32
21	40	30	35	25	45	32
19	60	45	50	35	50	40
22	50	35	60	45	50	40
24	35	25	45	32	40	30
25	60	45	50	30	50	35

Table I.10: General Data of CASE37

General Data	
Slack	701
Vnom (kV)	4.8
International System	0
DeltaLF	1
V_slack_ph_A	1.0283
V_slack_ph_B	1.0249
V_slack_ph_C	1.0112
Ang_slack_ph_A	-29.5322
Ang_slack_ph_B	-150.52
Ang_slack_ph_C	90.1923

Table I.11: Tolology of CASE37

Node A	Node B	Length	Config.
701	702	960	2
702	705	400	4
702	713	360	3
702	703	1320	2
703	727	240	4
703	730	600	3
704	714	80	4
704	720	800	3
705	742	320	4
705	712	240	4
706	725	280	4
707	724	760	4
707	722	120	4
708	733	320	3
708	732	320	4
709	731	600	3
709	708	320	3
710	735	200	4
710	736	1280	4
711	741	400	3
711	740	200	4
713	704	520	3
714	718	520	4
720	707	920	4
720	706	600	3
727	744	280	3
730	709	200	3
733	734	560	3
734	737	640	3
734	710	520	4
737	738	400	3
738	711	400	3
744	728	200	4
744	729	280	4

Table I.12: Line Parameters of CASE37

Conf	R11	R12	R13	R22	R23	R33
1	0.2926	0.0673	0.0337	0.2646	0.0673	0.2926
2	0.4751	0.1629	0.1234	0.4488	0.1629	0.4751
3	1.2936	0.4871	0.4585	1.3022	0.4871	1.2936
4	2.0952	0.5204	0.4926	2.1068	0.5204	2.0952
5	0	0	0	0	0	0
Conf	X11	X12	X13	X22	X23	X33
1	0.1973	-0.0368	-0.0417	0.19	-0.0368	0.1973
2	0.2973	-0.0326	-0.0607	0.2678	-0.0326	0.2973
3	0.6713	0.2111	0.1521	0.6326	0.2111	0.6713
4	0.7758	0.2738	0.2123	0.7398	0.2738	0.7758
5	1	0	0	1	0	1
Conf	B11	B12	B13	B22	B23	B33
1	159.7919	0	0	159.7919	0	159.7919
2	127.8306	0	0	127.8306	0	127.8306
3	74.8405	0	0	74.8405	0	74.8405
4	60.2483	0	0	60.2483	0	60.2483
5	1	0	0	1	0	1

Table I.13: Load Data of CASE37

Node	Ph-1 (kW)	Ph-1 (kVAr)	Ph-2 (kW)	Ph-2 (kWAr)	Ph-3 (KW)	Ph-3 (kVAr)
701	140	70	140	70	350	175
712	0	0	0	0	85	40
713	0	0	0	0	85	40
714	17	8	21	10	0	0
718	85	40	0	0	0	0
720	0	0	0	0	85	40
722	0	0	140	70	21	10
724	0	0	42	21	0	0
725	0	0	42	21	0	0
727	0	0	0	0	42	21
728	42	21	42	21	42	21
729	42	21	0	0	0	0
730	0	0	0	0	85	40
731	0	0	85	40	0	0
732	0	0	0	0	42	21
733	85	40	0	0	0	0
734	0	0	0	0	42	21
735	0	0	0	0	85	40
736	0	0	42	21	0	0
737	140	70	0	0	0	0
738	126	62	0	0	0	0
740	0	0	0	0	85	40
741	0	0	0	0	42	21
742	8	4	85	40	0	0
744	42	21	0	0	0	0

Table I.14: General Data of CASE28

General Data	
Slack	1
Vnom (kV)	4.16
International System	0
DeltaLF	0
V_slack_ph_A	1
V_slack_ph_B	1
V_slack_ph_C	1
Ang_slack_ph_A	0
Ang_slack_ph_B	-120
Ang_slack_ph_C	120
PV bus	3

Table I.15: Topology of CASE28

Node A	Node B	Length (ft.)	Config.
1	2	1000	1
2	3	500	1
2	6	500	2
3	4	500	1
3	18	500	2
4	5	500	2
4	23	400	2
4	26	1000	1
6	7	500	2
6	8	1000	2
7	9	500	2
7	14	500	2
7	16	500	2
9	10	500	2
10	11	300	2
11	12	200	3
11	13	200	3
14	15	300	2
14	17	300	3
14	27	1000	1
18	20	500	2
18	21	400	3
20	19	400	3
20	28	1000	1
21	22	400	3
23	24	400	2
24	25	400	3

Table I.16: Line Parameters of CASE28

Conf	R11	R12	R13	R22	R23	R33
1	0.3686	0.0169	0.0155	0.3757	0.0188	0.3723
2	0.9775	0.0167	0.0152	0.9844	0.0186	0.981
3	1.928	0.0161	0.0161	1.9308	0.0161	1.9337
Conf	X11	X12	X13	X22	X23	X33
1	0.6852	0.1515	0.1098	0.6715	0.2072	0.6782
2	0.8717	0.1697	0.1264	0.8654	0.2275	0.8648
3	1.4194	0.1183	0.1183	1.4215	0.1183	1.4236
Conf	B11	B12	B13	B22	B23	B33
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0

Table I.17: Load Data of CASE28

Node	Ph-1 (kW)	Ph-1 (kVAr)	Ph-2 (kW)	Ph-2 (kWAr)	Ph-3 (KW)	Ph-3 (kVAr)
2	0	0	0	0	0	0
3	35	25	40	30	45	32
6	40	30	45	32	35	25
4	50	40	60	45	50	35
18	40	30	40	30	40	30
5	40	30	40	30	40	30
23	60	45	50	40	50	35
7	0	0	0	0	0	0
8	40	30	40	30	40	30
9	60	45	50	40	50	35
14	50	35	50	40	60	45
16	40	30	40	30	40	30
10	35	25	40	30	45	32
11	45	32	35	25	40	30
12	50	35	60	45	50	40
13	35	25	45	32	40	30
15	133.3	100	133.3	100	133.3	100
17	40	30	35	25	45	32
20	35	25	40	30	45	32
21	40	30	35	25	45	32
19	60	45	50	35	50	40
22	50	35	60	45	50	40
24	35	25	45	32	40	30
25	60	45	50	30	50	35

Table I.18: Load and Voltage Data of CASE28

Node	Ph-1 (V)	Ph-1 (kW)	Ph-1 (kVAr)	Ph-2 (V)	Ph-2 (kW)	Ph-2 (kWAr)	Ph-3 (V)	Ph-3 (KW)	Ph-3 (kVAr)
26	0.9924	145	0	0.9926	145	0	0.9938	145	0
27	0.9838	65	0	0.984	65	0	0.9854	65	0
28	0.9902	65	0	0.9905	65	0	0.9917	65	0

Appendix II: : Data for Test Systems CASE6, CASE23, CASE38, and CASE33

Table II.1: Line Data of CASE6

Node A	Node B	R	X
1	2	0.267	0.074
1	4	0.186	0.082
2	5	0.124	0.058
2	3	0.093	0.431
3	6	0.031	0.012

Table II.2: Active Load Data of CASE6

Node	Load (kW)	a_p	b_p	c_p	α_p	β_p
1	0.161	0	0	0	1	2
2	0	0	0	0	1	0
3	0.215	0	0	0	1	2
4	0	0	0	0	1	0
5	0	0	0	0	1	0
6	0	0	0	0	1	0

Table II.3: Reactive Load Data of CASE6

Node	Load (kVar)	a_q	b_q	c_q	α_q	β_q
1	0.107	0	0	0	1	2
2	0	0	0	0	1	0
3	0.152	0	0	0	1	2
4	0	0	0	0	1	0
5	0	0	0	0	1	0
6	0	0	0	0	1	0

Table II.4: DG's Data of CASE6

Node	m_p	n_q
5	0.00748	0.217323
6	0.00748	0.217323
4	0.00748	0.217323

Table II.5: Line Data of CASE22

Node A	Node B	R	X
1	2	0.030281	0.014934
2	3	0.004521	0.002331
2	4	0.04476	0.02305
4	5	0.01595	0.008182
5	6	0.108347	0.055802
6	7	0.004942	0.002545
6	8	0.024008	0.012364
4	9	0.061413	0.031628
9	10	0.004521	0.002331
9	11	0.055785	0.028769
11	12	0.004521	0.002331
11	13	0.032579	0.016777
13	14	0.086446	0.044529
14	15	0.001818	0.000959
14	16	0.004521	0.002331
16	17	0.026545	0.013669
17	18	0.007843	0.004033
17	19	0.047438	0.024455
19	20	0.010678	0.005455
20	21	0.007198	0.003719
20	22	0.044041	0.022678

Table II.6: Active Load Data of CASE22

Node	Load (kW)	a_p	b_p	c_p	α_p	β_p
1	0	0	0	0	1	0
2	0.00336	0	0	0	1	0
3	0.00336	0	0	0	1	0
4	0.00676	0	0	0	1	0
5	0.00292	0	0	0	1	0
6	0.0021	0	0	0	1	0
7	0.00176	0	0	0	1	0
8	0.00288	0	0	0	1	0
9	0.00386	0	0	0	1	0
10	0.00288	0	0	0	1	0
11	0.00326	0	0	0	1	0
12	0.00326	0	0	0	1	0
13	0.01642	0	0	0	1	0
14	0.00694	0	0	0	1	0
15	0.00694	0	0	0	1	0
16	0.01606	0	0	0	1	0
17	0.00992	0	0	0	1	0
18	0.00992	0	0	0	1	0
19	0.00876	0	0	0	1	0
20	0.00746	0	0	0	1	0
21	0.00746	0	0	0	1	0
22	0.0062	0	0	0	1	0

Table II.7: Reactive Load Data of CASE22

Node	Load (kVar)	a_q	b_q	c_q	α_q	β_q
1	0	0	0	0	1	0
2	0.00418	0	0	0	1	0
3	0.00418	0	0	0	1	0
4	0.00746	0	0	0	1	0
5	0.0025	0	0	0	1	0
6	0.00284	0	0	0	1	0
7	0.00234	0	0	0	1	0
8	0.00372	0	0	0	1	0
9	0.00518	0	0	0	1	0
10	0.00372	0	0	0	1	0
11	0.0039	0	0	0	1	0
12	0.0039	0	0	0	1	0
13	0.01434	0	0	0	1	0
14	0.00602	0	0	0	1	0
15	0.00602	0	0	0	1	0
16	0.01402	0	0	0	1	0
17	0.00956	0	0	0	1	0
18	0.00956	0	0	0	1	0
19	0.00778	0	0	0	1	0
20	0.0072	0	0	0	1	0
21	0.0072	0	0	0	1	0
22	0.00588	0	0	0	1	0

Table II.8: DG's Data of CASE22

Node	m_p	n_q
5	0.005102	0.05
13	0.001502	0.03
15	0.004506	0.01
21	0.001502	0.02

Table II.9: Line Data of CASE38

Node A	Node B	R	X
1	2	0.000574	0.000293
2	3	0.00307	0.001564
3	4	0.002279	0.001161
4	5	0.002373	0.001209
5	6	0.0051	0.004402
6	7	0.00116	0.003853
7	8	0.00443	0.001464
8	9	0.006411	0.004668
9	10	0.006501	0.004608
10	11	0.001224	0.000405
11	12	0.002331	0.000771
12	13	0.009141	0.007192
13	14	0.003372	0.004439
14	15	0.00368	0.003275
15	16	0.004647	0.003394
16	17	0.008026	0.010716
17	18	0.004558	0.003574
2	19	0.001021	0.000974
19	20	0.009366	0.00844
20	21	0.00255	0.002979
21	22	0.004414	0.005836
3	23	0.002809	0.00192
23	24	0.005592	0.004415
24	25	0.005579	0.004366
6	26	0.001264	0.000644
26	27	0.00177	0.000901
27	28	0.006594	0.005814
28	29	0.005007	0.004362
29	30	0.00316	0.00161
30	31	0.006067	0.005996
31	32	0.001933	0.002253
32	33	0.002123	0.003301
8	34	0.012453	0.012453
9	35	0.012453	0.012453
12	36	0.012453	0.012453
18	37	0.003113	0.003113
25	38	0.003113	0.003113

Table II.10: Active Load Data of CASE38

Node	Load (kW)	a_p	b_p	c_p	α_p	β_p
1	0	0	0	0	1	0
2	0.1	0	0	0	1	0.92
3	0.09	0	0	0	1	0.18
4	0.12	0	0	0	1	1.51
5	0.06	0	0	0	1	0.92
6	0.06	0	0	0	1	0.18
7	0.2	0	0	0	1	1.51
8	0.2	0	0	0	1	1.51
9	0.06	0	0	0	1	0.18
10	0.06	0	0	0	1	1.51
11	0.045	0	0	0	1	1.51
12	0.06	0	0	0	1	0.92
13	0.06	0	0	0	1	1.51
14	0.12	0	0	0	1	0.92
15	0.06	0	0	0	1	1.51
16	0.06	0	0	0	1	0.18
17	0.06	0	0	0	1	1.51
18	0.09	0	0	0	1	0.18
19	0.09	0	0	0	1	0.92
20	0.09	0	0	0	1	1.51
21	0.09	0	0	0	1	0.18
22	0.09	0	0	0	1	0.92
23	0.09	0	0	0	1	1.51
24	0.42	0	0	0	1	1.51
25	0.42	0	0	0	1	1.51
26	0.06	0	0	0	1	1.51
27	0.06	0	0	0	1	0.18
28	0.06	0	0	0	1	1.51
29	0.12	0	0	0	1	1.51
30	0.2	0	0	0	1	1.51
31	0.15	0	0	0	1	0.92
32	0.21	0	0	0	1	0.92
33	0.06	0	0	0	1	1.51
34	0	0	0	0	1	0
35	0	0	0	0	1	0
36	0	0	0	0	1	0
37	0	0	0	0	1	0
38	0	0	0	0	1	0

Table II.11: Reactive Load Data of CASE38

Node	Load (kVar)	a_q	b_q	c_q	α_q	β_q
1	0	0	0	0	1	0
2	0.06	0	0	0	1	4.04
3	0.04	0	0	0	1	6
4	0.08	0	0	0	1	3.4
5	0.03	0	0	0	1	4.04
6	0.02	0	0	0	1	6
7	0.1	0	0	0	1	3.4
8	0.1	0	0	0	1	3.4
9	0.02	0	0	0	1	6
10	0.02	0	0	0	1	3.4
11	0.03	0	0	0	1	3.4
12	0.035	0	0	0	1	4.04
13	0.035	0	0	0	1	3.4
14	0.08	0	0	0	1	4.04
15	0.01	0	0	0	1	3.4
16	0.02	0	0	0	1	6
17	0.02	0	0	0	1	3.4
18	0.04	0	0	0	1	6
19	0.04	0	0	0	1	4.04
20	0.04	0	0	0	1	3.4
21	0.04	0	0	0	1	6
22	0.04	0	0	0	1	4.04
23	0.05	0	0	0	1	3.4
24	0.2	0	0	0	1	3.4
25	0.2	0	0	0	1	3.4
26	0.025	0	0	0	1	3.4
27	0.025	0	0	0	1	6
28	0.02	0	0	0	1	3.4
29	0.07	0	0	0	1	3.4
30	0.6	0	0	0	1	3.4
31	0.07	0	0	0	1	4.04
32	0.1	0	0	0	1	4.04
33	0.04	0	0	0	1	3.4
34	0	0	0	0	1	0
35	0	0	0	0	1	0
36	0	0	0	0	1	0
37	0	0	0	0	1	0
38	0	0	0	0	1	0

Table II.12: DG's Data of CASE38

Node	m_p	n_q
34	0.005102	0.05
35	0.001502	0.03
36	0.004506	0.05
37	0.002253	0.01
38	0.002253	0.1

Table II.13: Line Data of CASE33

Node A	Node B	R	X
1	2	0.000288	0.000147
2	3	0.001538	0.000783
3	4	0.001142	0.000581
4	5	0.001189	0.000606
5	6	0.002555	0.002206
6	7	0.000584	0.00193
7	8	0.002219	0.000733
8	9	0.003213	0.002309
9	10	0.003257	0.002309
10	11	0.000613	0.000203
11	12	0.001168	0.000386
12	13	0.00458	0.003603
13	14	0.00169	0.002224
14	15	0.001844	0.001641
15	16	0.002328	0.0017
16	17	0.004021	0.005369
17	18	0.002284	0.001791
2	19	0.000512	0.000488
19	20	0.004693	0.004228
20	21	0.001277	0.001492
21	22	0.002212	0.002924
3	23	0.001408	0.000962
23	24	0.002801	0.002212
24	25	0.002795	0.002187
6	26	0.000633	0.000323
26	27	0.000887	0.000451
27	28	0.003304	0.002913
28	29	0.002509	0.002186
29	30	0.001583	0.000806
30	31	0.00304	0.003004
31	32	0.000969	0.001129
32	33	0.001064	0.001654

Table II.14: Active Load Data of CASE33

Node	Load (kW)	a_p	b_p	c_p	α_p	β_p
1	0	0	0	0	1	0
2	0.2	0	0	0	1	0
3	0.18	0	0	0	1	0
4	0.24	0	0	0	1	0
5	0.12	0	0	0	1	0
6	0.78	0	0	0	1	0
7	0.4	0	0	0	1	0
8	0.4	0	0	0	1	0
9	0.12	0	0	0	1	0
10	0.12	0	0	0	1	0
11	0.09	0	0	0	1	0
12	0.12	0	0	0	1	0
13	0.78	0	0	0	1	0
14	0.24	0	0	0	1	0
15	0.12	0	0	0	1	0
16	0.12	0	0	0	1	0
17	0.12	0	0	0	1	0
18	0.18	0	0	0	1	0
19	0.18	0	0	0	1	0
20	0.18	0	0	0	1	0
21	0.18	0	0	0	1	0
22	0.18	0	0	0	1	0
23	0.18	0	0	0	1	0
24	0.84	0	0	0	1	0
25	0.06	0	0	0	1	0
26	0.12	0	0	0	1	0
27	0.12	0	0	0	1	0
28	0.12	0	0	0	1	0
29	0.24	0	0	0	1	0
30	0.4	0	0	0	1	0
31	0.3	0	0	0	1	0
32	0.42	0	0	0	1	0
33	0.78	0	0	0	1	0

Table II.15: Reactive Load Data of CASE33

Node	Load (kVar)	a_q	b_q	c_q	α_q	β_q
1	0	0	0	0	1	0
2	0.08	0	0	0	1	0
3	0.16	0	0	0	1	0
4	0.06	0	0	0	1	0
5	0.86	0	0	0	1	0
6	0.2	0	0	0	1	0
7	0.2	0	0	0	1	0
8	0.04	0	0	0	1	0
9	0.04	0	0	0	1	0
10	0.06	0	0	0	1	0
11	0.07	0	0	0	1	0
12	0.83	0	0	0	1	0
13	0.16	0	0	0	1	0
14	0.02	0	0	0	1	0
15	0.04	0	0	0	1	0
16	0.04	0	0	0	1	0
17	0.08	0	0	0	1	0
18	0.08	0	0	0	1	0
19	0.08	0	0	0	1	0
20	0.08	0	0	0	1	0
21	0.08	0	0	0	1	0
22	0.1	0	0	0	1	0
23	0.4	0	0	0	1	0
24	0.5	0	0	0	1	0
25	0.05	0	0	0	1	0
26	0.05	0	0	0	1	0
27	0.04	0	0	0	1	0
28	0.14	0	0	0	1	0
29	1.2	0	0	0	1	0
30	0.14	0	0	0	1	0
31	0.2	0	0	0	1	0
32	0.82	0	0	0	1	0
33	0.78	0	0	0	1	0

Table II.16: DG's Data of CASE33

Node	m_p	n_q
1	0.005	0.005
6	0.1	0.1
13	0.01	0.01
25	0.1	0.1
33	0.02	0.02

Appendix III

A. Performance of ϵDE-GN on Benchmark Problems

Table III.1: Experimental Results of ϵDE-GN on CEC-2006 Benchmark Suite.

Prob	Min	Median	Mean	Std	Worst	FR	SR
1	32686	34385	34297	681	35362	100	100
2	107160	132320	130334	9273	144980	100	100
3	54670	87320	86264	11455	103030	100	100
4	20195	24075	23881	1559	26020	100	100
5	16712	18984	18818	751	19848	100	100
6	20022	22580	22424	1151	23932	100	100
7	124390	140200	138878	5626	145270	100	100
8	550	2350	2279	582	3030	100	100
9	50593	55988	55477	2450	58959	100	100
10	121256	132416	132164	5970	142152	100	100
11	2398	4074	3845	671	4710	100	100
12	120	123	124	2	126	100	100
13	9405	29160	28606	9632	42460	100	100
14	64010	70630	70660	3671	75390	100	100
15	7714	11589	11313	1109	12419	100	100
16	18190	22570	22409	1896	26865	100	100
17	46050	67258	69648	16313	95702	100	100
18	95624	110575	110915	6279	119776	100	100
19	181220	199515	200888	9800	217365	100	100
21	46468	50736	50655	2229	53847	100	100
23	145855	198620	199828	26450	253102	100	100
24	1244	3538	3362	617	4148	100	100

Table III.2: Comparison of algorithms on CEC-2006 benchmark problems

Algorithms	mean	FR	SR	SP	overall	rank
ϵDE-GN	1	1	1	3	6	1
DE	8	5	9	5	27	8
DMS	4	1	4	6	15	3
e-DE	2	1	1	7	11	2
GDE	11	11	10	9	41	10
jDE-2	9	5	8	10	32	9
MDE	5	5	5	1	16	4
MPDE	6	10	5	4	25	7
PCX	3	5	3	8	19	6
PESO+	10	9	11	11	41	10
SaDE	7	1	7	2	17	5

B. Performance of υMAESlm on Benchmark Problems

Table III.3: Experimental results of υMA-ESbm over 25 independent run on 18 test problems with 10D of IEEE CEC 2010.

Prob	1	2	3	4	5	6	7	8	9
best	-7.47E-01	-2.28E+00	0.00E+00	-2.00E-05	-4.84E+02	-5.79E+02	0.00E+00	0.00E+00	0.00E+00
median	-7.47E-01	-2.28E+00	0.00E+00	-2.00E-05	-4.75E+02	-5.79E+02	0.00E+00	7.65E+00	0.00E+00
c_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$\bar{\nu}$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
mean	-7.46E-01	-2.26E+00	0.00E+00	-2.00E-05	-4.84E+02	-5.70E+02	0.00E+00	3.27E+00	0.00E+00
std	5.90E-03	1.91E-02	0.00E+00	9.65E-09	2.46E-02	4.14E+01	0.00E+00	4.81E+00	0.00E+00
worst	-7.29E-01	-2.21E+00	0.00E+00	-2.00E-05	-4.26E+02	-3.71E+02	0.00E+00	1.09E+01	0.00E+00
FR	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
vio	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Prob	10	11	12	13	14	15	16	17	18
best	0.00E+00	-2.15E-03	-1.16E+02	-6.35E+01	0.00E+00	0.00E+00	0.00E+00	4.90E-11	0.00E+00
median	0.00E+00	-2.15E-03	-2.03E-01	-6.16E+01	0.00E+00	0.00E+00	0.00E+00	4.53E-02	6.16E-33
c_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$\bar{\nu}$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
mean	0.00E+00	-2.15E-03	-4.84E+00	-6.01E+01	0.00E+00	0.00E+00	0.00E+00	3.10E-02	7.87E-31
std	0.00E+00	0.00E+00	2.32E+01	3.26E+00	0.00E+00	0.00E+00	0.00E+00	5.21E-01	3.89E-30
worst	0.00E+00	-2.15E-03	-2.03E-01	-5.41E+01	0.00E+00	0.00E+00	0.00E+00	6.43E-01	1.94E-29
FR	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
vio	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table III.4: Experimental results of υMA-ESbm over 25 independent run on 18 test problems with 30D of IEEE CEC 2010.

Prob	1	2	3	4	5	6	7	8	9
best	-8.22E-01	-2.28E+00	2.14E-19	-6.67E-06	-4.84E+02	-5.31E+02	1.78E-18	5.03E-22	3.01E-26
median	-8.20E-01	-2.28E+00	1.52E-17	-6.67E-06	-4.84E+02	-2.47E+02	3.00E-17	9.77E-14	2.10E-07
c_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$\bar{\nu}$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
mean	-8.17E-01	-2.27E+00	2.06E-17	-6.50E-06	-4.02E+02	-5.14E+02	2.81E-17	1.36E-14	1.16E+00
std	7.87E-03	1.31E-02	3.07E-17	7.20E-07	1.23E+02	2.08E+02	1.60E-17	1.24E-13	1.04E+00
worst	-7.89E-01	-2.23E+00	1.53E-16	-3.06E-06	-2.64E+01	-2.30E+01	5.71E-17	4.74E-13	1.18E+00
FR	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
vio	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Prob	10	11	12	13	14	15	16	17	18
best	4.00E-28	-5.54E-04	-2.03E-01	-6.23E+01	6.73E-26	7.03E-22	0.00E+00	2.27E-07	7.67E-31
median	4.49E-10	-5.54E-04	-2.03E-01	-6.05E+01	5.81E-22	1.73E-19	0.00E+00	8.19E-06	8.81E-25
c_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
c_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$\bar{\nu}$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
mean	1.31E+00	-5.54E-04	-2.03E-01	-5.93E+01	5.66E-18	4.72E-18	0.00E+00	3.35E-04	2.76E-24
std	2.67E+00	9.88E-09	1.36E-08	2.59E+00	6.13E-18	2.11E-17	0.00E+00	1.08E-03	1.06E-23
worst	6.55E+00	-5.54E-04	-2.03E-01	-5.33E+01	2.53E-17	1.06E-17	0.00E+00	5.35E-03	5.10E-23
FR	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
vio	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table III.5: Experimental results of υMA-ESbm, CMODE, ϵDEag, ECHT-DE, ITLBO, AIS-IRP, FROFI, Co-CLPSO, and C^{2}oDE over 25 independent runs on 18 test problems with $10D$ of IEEE CEC 2010. (Mean and SD represent the average and standard deviation of the objective function values obtained in 25 runs, respectively. t-test at 0.05 significance level is performed between υMA-ESbm and other contenders. '***' indicates that feasible solutions cannot be consistently found by the corresponding algorithms in all runs.)

Prob	υMA-ESbm		CMODE			ϵDEag			ECHT-DE			ITLBO		
	Mean	SD	Mean	SD	t	Mean	SD	t	Mean	SD	t	Mean	SD	t
c01	-7.46E-01	5.90E-03	-7.47E-01	2.35E-13	=	**-7.47E-01**	**1.32E-03**	=	**-7.47E-01**	**1.40E-03**	=	**-7.47E-01**	**1.87E-03**	=
c02	-2.26E+00	3.14E-02	***	***	+	-2.26E+00	2.39E-02	=	**-2.27E+00**	**6.70E-03**	=	-2.03E+00	8.14E-02	+
c03	**0.00E+00**	**0.00E+00**	2.84E+00	4.23E+00	+	**0.00E+00**	**0.00E+00**	=	**0.00E+00**	**0.00E+00**	=	**0.00E+00**	**0.00E+00**	=
c04	**-2.00E-05**	**9.65E-09**	-9.99E-06	2.90E-08	+	-9.92E-06	1.55E-07	+	-1.00E-05	0.00E+00	+	-1.00E-05	3.39E-15	+
c05	-4.84E+02	2.46E-02	***	***	+	**-4.84E+02**	**3.89E-13**	=	-4.11E+02	7.63E+01	+	**-4.84E+02**	**1.11E-11**	=
c06	-5.70E+02	4.14E+01	-5.78E+02	1.60E-02	=	**-5.79E+02**	**3.63E-03**	=	-5.62E+02	4.51E+01	+	-5.79E+02	2.39E-04	-
c07	**0.00E+00**	**0.00E+00**	6.69E-15	8.95E-15	+	**0.00E+00**	**0.00E+00**	=	1.33E-01	7.28E-01	+	**0.00E+00**	**0.00E+00**	=
c08	3.27E+00	4.81E+00	8.94E+00	3.98E+00	+	6.73E+00	5.56E+00	+	6.16E+00	6.45E+00	=	8.47E+00	4.09E+00	+
c09	**0.00E+00**	**0.00E+00**	***	***	+	**0.00E+00**	**0.00E+00**	-	1.47E-01	8.05E-01	+	**0.00E+00**	**0.00E+00**	=
c10	**0.00E+00**	**0.00E+00**	***	***	+	**0.00E+00**	**0.00E+00**	=	1.71E+00	7.66E+00	+	1.92E-01	9.62E-01	+
c11	**-2.15E-03**	**0.00E+00**	***	***	+	-1.52E-03	6.34E-11	+	***	***	+	-1.51E-03	1.30E-05	+
c12	-4.84E+00	2.32E+01	***	***	+	-3.37E+02	1.78E+02	-	***	***	+	-2.39E+01	1.14E+02	=
c13	-6.01E+01	3.26E+00	-5.79E+01	4.09E+00	=	**-6.84E+01**	**1.03E-06**	-	-6.51E+01	2.38E+00	-	-6.52E+01	1.78E+00	-
c14	**0.00E+00**	**0.00E+00**	8.18E-09	1.64E-08	+	**0.00E+00**	**0.00E+00**	=	7.02E+05	3.19E+06	+	**0.00E+00**	**0.00E+00**	=
c15	**0.00E+00**	**0.00E+00**	1.20E+02	3.48E+02	+	1.80E-01	8.81E-01	+	2.34E+13	5.30E+13	+	3.84E+00	4.97E+00	+
c16	**0.00E+00**	**0.00E+00**	6.82E-05	1.49E-04	+	3.70E-01	3.71E-01	+	3.93E-02	4.28E-02	+	2.27E-01	3.11E-01	+
c17	3.10E-02	5.21E-01	4.37E-02	1.12E-01	-	1.25E-01	1.94E-01	+	1.12E-01	3.32E-01	=	3.91E-01	6.71E-01	+
c18	1.73E-28	8.53E-28	5.75E+00	2.64E+02	+	9.68E-19	1.81E-18	+	**0.00E+00**	**0.00E+00**	=	**0.00E+00**	**0.00E+00**	=
+/=/-			14/3/1			7/8/3			11/5/2			8/8/2		

Table III.6: Experimental results of υMA-ESbm, CMODE, ϵDEag, ECHT-DE, ITLBO, AIS-IRP, FROFI, Co-CLPSO, and C^{2}oDE over 25 independent runs on 18 test problems with $30D$ of IEEE CEC 2010. (Mean and SD represent the average and standard deviation of the objective function values obtained in 25 runs, respectively. t-test at 0.05 significance level is performed between υMA-ESbm and other contenders. '***' indicates that feasible solutions cannot be consistently found by the corresponding algorithms in all runs.)

Prob	υMA-ESbm		CMODE			ϵDEag			ECHT-DE			ITLBO		
	Mean	SD	Mean	SD	t	Mean	SD	t	Mean	SD	t	Mean	SD	t
c01	-8.17E-01	7.87E-03	-8.20E-01	8.95E-04	=	**-8.21E-01**	**7.10E-04**	=	-8.00E-01	1.79E-02	+	-8.20E-01	9.95E-04	=
c02	**-2.27E+00**	**4.95E-02**	9.75E-01	6.25E+01	+	-2.15E+00	1.20E-02	+	-1.99E+00	2.10E-01	+	-2.03E+00	7.64E-02	+
c03	**3.44E-05**	**9.51E-04**	2.18E+01	1.25E+01	+	2.88E+01	8.05E-01	+	9.89E+01	6.26E+01	+	7.84E+01	6.31E+01	+
c04	**-5.27E-06**	**1.76E-06**	6.72E-04	4.24E-04	+	8.16E-03	3.07E-03	+	-1.03E-06	9.01E-03	+	1.69E-03	1.14E-03	+
c05	-4.02E+02	1.23E+02	***	***	+	-4.50E+02	2.90E+00	-	-1.06E+02	1.67E+02	+	**-4.82E+01**	**1.73E+00**	+
c06	-5.14E+02	2.08E+02	***	***	+	-5.28E+02	4.75E-01	=	-1.38E+02	9.89E+01	+	**-5.30E+02**	**4.80E-01**	-
c07	2.05E-17	3.63E-16	5.24E-05	5.89E-05	+	2.60E-15	1.23E-15	=	1.33E-01	7.28E-01	+	1.59E-01	7.97E-01	+
c08	1.36E-14	1.24E-13	3.68E-01	2.62E-01	+	7.83E-14	4.86E-14	=	3.36E+01	1.11E+02	+	1.14E+01	2.79E+01	+
c09	**1.16E+00**	**3.04E+00**	***	***	+	1.07E+01	2.82E+01	+	4.24E+01	1.38E+02	+	2.86E+00	1.43E+01	+
c10	**1.31E+00**	**2.67E+00**	***	***	+	3.33E+01	4.55E-01	+	5.34E+01	8.83E+01	+	3.29E+01	1.41E+01	+
c11	-5.54E-04	9.88E-09	***	***	+	-2.86E-04	2.71E-05	+	***	***	+	-3.86E-04	1.14E-05	+
c12	**-2.03E-01**	**1.36E-08**	***	***	+	***	***	+	***	***	+	-1.98E-01	2.39E-03	+
c13	-5.77E+01	4.36E+00	-3.89E+01	2.17E+00	+	-6.54E+01	5.73E-01	-	-6.46E+01	1.67E+00	-	-5.05E+01	1.18E+00	+
c14	5.66E-18	6.13E-18	9.31E+00	2.46E+00	+	3.09E+13	5.61E-13	+	1.24E+05	6.77E+05	+	4.78E-01	1.32E+00	+
c15	**4.72E-18**	**2.11E-17**	1.51E+13	8.26E+12	+	2.16E+01	1.10E-04	+	1.94E+11	4.35E+11	+	2.38E+01	2.51E+01	+
c16	**0.00E+00**	**0.00E+00**	6.30E-02	2.72E-02	+	2.17E-21	1.06E-20	=	**0.00E+00**	**0.00E+00**	=	**0.00E+00**	**0.00E+00**	=
c17	**3.35E-04**	**1.08E-03**	**3.12E+02**	**2.75E+02**	+	6.33E+00	4.99E+00	+	2.75E-01	3.78E-01	+	9.65E-01	1.73E+00	+
c18	2.76E-24	1.06E-23	7.36E+03	3.12E+03	+	8.75E+01	1.66E+02	+	**0.00E+00**	**0.00E+00**	=	9.07E-17	3.18E-16	+
+/=/-			17/1/0			11/5/2			15/2/1			15/2/1		

C. Performance of ESHADE on Standard Benchmark Problem.

Table III.7: number of trials of ESHADE in a run of 50 that found correct digits

Function	Number of correct digits											Score
	0	1	2	3	4	5	6	7	8	9	10	
1	0	0	0	0	0	0	0	0	0	0	50	10
2	0	0	0	0	0	0	0	0	0	0	50	10
3	0	0	0	0	0	0	0	0	0	0	50	10
4	0	0	0	0	0	0	0	0	0	0	50	10
5	0	0	0	0	0	0	0	0	0	0	50	10
6	0	0	0	0	0	0	0	0	0	0	50	10
7	0	0	0	0	0	0	0	0	0	0	50	10
8	0	2	48	0	0	0	0	0	0	0	0	2
9	0	0	50	13	0	0	0	0	0	0	0	2.52
10	0	0	0	0	0	0	0	0	0	0	50	10
Total												84.52

Table III.8: Score achieved by HSES, EBOwithCMAR and ESHADE for problem suite of 100-Digit Challenge.

Function	HSES	EBOwithCMAR	ESHADE
1	**10**	**10**	**10**
2	0.2	**10**	**10**
3	1.72	**10**	**10**
4	4.96	**10**	**10**
5	**10**	**10**	**10**
6	**10**	**10**	**10**
7	0.28	0.28	**10**
8	0.16	1.12	**2**
9	3	3	**2.52**
10	**10**	8.64	**10**
Total	50.32	73.04	**84.52**

Appendix IV: Power Flow results of different Systems

Chapter-4

A. CASE22

A.1. Case 1:

Table IV.1: Power Flow solution of CASE22 test system operating in conventional droop.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9868	0.0000	0.0000	0.0000	0.0000	0.0000	12	0.9943	0.0057	-0.0163	-0.0195	0.0256	2.2728
2	0.9868	0.0000	-0.0168	-0.0209	0.0272	2.2479	13	0.9986	0.0064	0.1720	-0.0256	0.1741	0.1543
3	0.9866	0.0001	-0.0168	-0.0209	0.0272	2.2479	14	0.9959	-0.0018	-0.0347	-0.0301	0.0461	2.4253
4	0.9893	-0.0011	-0.0338	-0.0373	0.0509	2.3059	15	0.9963	-0.0023	0.0500	0.3364	0.3414	-1.4256
5	0.9907	-0.0030	0.0602	0.1725	0.1845	-1.2381	16	0.9950	-0.0008	-0.0803	-0.0701	0.1071	2.4231
6	0.9845	0.0000	-0.0105	-0.0142	0.0179	2.2075	17	0.9927	0.0039	-0.0496	-0.0478	0.0694	2.3786
7	0.9844	0.0001	-0.0088	-0.0117	0.0149	2.2157	18	0.9921	0.0041	-0.0496	-0.0478	0.0694	2.3788
8	0.9839	0.0003	-0.0144	-0.0186	0.0239	2.2299	19	0.9957	0.0102	-0.0438	-0.0389	0.0588	2.4256
9	0.9903	0.0033	-0.0193	-0.0259	0.0326	2.2145	20	0.9971	0.0115	-0.0373	-0.0360	0.0520	2.3854
10	0.9902	0.0033	-0.0144	-0.0186	0.0238	2.2329	21	0.9987	0.0121	0.2168	0.0266	0.2187	-0.1100
11	0.9945	0.0057	-0.0163	-0.0195	0.0256	2.2727	22	0.9950	0.0121	-0.0310	-0.0294	0.0429	2.3947
w	0.9996												

A.2. Case 2:

Table IV.2: Power Flow solution of CASE22 test system operating in inverse droop.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9881	0.0000	0.0000	0.0000	0.0000	3.1416	12	0.9933	-0.0123	-0.0163	-0.0195	0.0256	2.2548
2	0.9881	0.0000	-0.0168	-0.0209	0.0271	2.2479	13	0.9970	-0.0166	0.0189	0.1794	0.1809	-1.4827
3	0.9880	0.0001	-0.0168	-0.0209	0.0271	2.2479	14	0.9967	-0.0132	-0.0347	-0.0301	0.0461	2.4139
4	0.9906	-0.0011	-0.0338	-0.0373	0.0508	2.3059	15	0.9972	-0.0130	0.2453	0.0536	0.2518	-0.2281
5	0.9924	-0.0005	0.1374	0.0614	0.1516	-0.4210	16	0.9957	-0.0134	-0.0803	-0.0701	0.1071	2.4105
6	0.9862	0.0025	-0.0105	-0.0142	0.0179	2.2100	17	0.9928	-0.0154	-0.0496	-0.0478	0.0694	2.3593
7	0.9861	0.0025	-0.0088	-0.0117	0.0148	2.2182	18	0.9922	-0.0152	-0.0496	-0.0478	0.0694	2.3595
8	0.9856	0.0027	-0.0144	-0.0186	0.0239	2.2324	19	0.9947	-0.0211	-0.0438	-0.0389	0.0589	2.3943
9	0.9904	-0.0062	-0.0193	-0.0259	0.0326	2.2050	20	0.9958	-0.0225	-0.0373	-0.0360	0.0521	2.3514
10	0.9903	-0.0061	-0.0144	-0.0186	0.0238	2.2235	21	0.9973	-0.0237	0.0967	0.2151	0.2365	-1.1721
11	0.9934	-0.0123	-0.0163	-0.0195	0.0256	2.2547	22	0.9938	-0.0219	-0.0310	-0.0294	0.0430	2.3608
w	1.0004												

A.3. Case 3:

Table IV.3: Power Flow solution of CASE22 test system operating in mixed droop.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9832	0.0000	0.0000	0.0000	0.0000	3.1416	12	0.9885	-0.0046	-0.0163	-0.0195	0.0257	2.2624
2	0.9832	0.0000	-0.0168	-0.0209	0.0273	2.2479	13	0.9921	-0.0069	0.0501	0.0582	0.0774	-0.8664
3	0.9831	0.0001	-0.0168	-0.0209	0.0273	2.2479	14	0.9945	-0.0098	-0.0347	-0.0301	0.0462	2.4173
4	0.9857	-0.0011	-0.0338	-0.0373	0.0511	2.3059	15	0.9951	-0.0100	0.2099	0.2137	0.3010	-0.8044
5	0.9875	-0.0016	0.1106	0.1120	0.1594	-0.7933	16	0.9934	-0.0095	-0.0803	-0.0701	0.1073	2.4144
6	0.9813	0.0014	-0.0105	-0.0142	0.0180	2.2089	17	0.9901	-0.0087	-0.0496	-0.0478	0.0696	2.3660
7	0.9812	0.0015	-0.0088	-0.0117	0.0149	2.2171	18	0.9895	-0.0085	-0.0496	-0.0478	0.0696	2.3662
8	0.9807	0.0017	-0.0144	-0.0186	0.0240	2.2313	19	0.9912	-0.0093	-0.0438	-0.0389	0.0591	2.4061
9	0.9856	-0.0022	-0.0193	-0.0259	0.0328	2.2090	20	0.9921	-0.0096	-0.0373	-0.0360	0.0522	2.3643
10	0.9854	-0.0021	-0.0144	-0.0186	0.0239	2.2275	21	0.9935	-0.0101	0.1257	0.1247	0.1782	-0.7913
11	0.9886	-0.0047	-0.0163	-0.0195	0.0257	2.2624	22	0.9901	-0.0090	-0.0310	-0.0294	0.0432	2.3736
w	1.0000												

A.4. Case 4:

Table IV.4: Power Flow solution of CASE22 test system operating in isochronous mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9836	0.0000	0.0000	0.0000	0.0000	0.0000	12	0.9891	-0.0062	-0.0163	-0.0195	0.0257	2.2609
2	0.9836	0.0000	-0.0168	-0.0209	0.0273	2.2479	13	0.9928	-0.0088	0.1578	-0.1243	0.2023	0.6584
3	0.9835	0.0001	-0.0168	-0.0209	0.0273	2.2479	14	0.9945	-0.0337	-0.0347	-0.0301	0.0462	2.3933
4	0.9861	-0.0011	-0.0338	-0.0373	0.0510	2.3059	15	0.9951	-0.0339	0.2200	0.2071	0.3036	-0.7890
5	0.9879	-0.0014	0.1144	0.1011	0.1545	-0.7248	16	0.9933	-0.0347	-0.0803	-0.0701	0.1073	2.3892
6	0.9816	0.0017	-0.0105	-0.0142	0.0180	2.2092	17	0.9897	-0.0409	-0.0496	-0.0478	0.0696	2.3338
7	0.9815	0.0017	-0.0088	-0.0117	0.0149	2.2174	18	0.9891	-0.0407	-0.0496	-0.0478	0.0696	2.3339
8	0.9810	0.0019	-0.0144	-0.0186	0.0240	2.2315	19	0.9905	-0.0543	-0.0438	-0.0389	0.0591	2.3611
9	0.9861	-0.0030	-0.0193	-0.0259	0.0328	2.2082	20	0.9913	-0.0574	-0.0373	-0.0360	0.0523	2.3165
10	0.9859	-0.0029	-0.0144	-0.0186	0.0239	2.2267	21	0.9927	-0.0598	0.0153	0.3305	0.3333	-1.5844
11	0.9892	-0.0062	-0.0163	-0.0195	0.0257	2.2608	22	0.9893	-0.0568	-0.0310	-0.0294	0.0432	2.3258
w	0.9999												

B. CASE38

B.1. Case 1:

Table IV.5: Power Flow solution of CASE38 test system operating in conventional mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9322	0.0000	0.0000	0.0000	0.0000	0.0000	20	0.9284	-0.0018	-0.0804	-0.0311	0.0929	2.7712
2	0.9322	0.0000	-0.0937	-0.0452	0.1116	2.6924	21	0.9278	-0.0022	-0.0888	-0.0255	0.0996	2.8597
3	0.9339	0.0002	-0.0889	-0.0265	0.0993	2.8517	22	0.9272	-0.0026	-0.0840	-0.0295	0.0960	2.8014
4	0.9353	0.0010	-0.1085	-0.0637	0.1345	2.6114	23	0.9342	-0.0005	-0.0812	-0.0397	0.0967	2.6867
5	0.9371	0.0017	-0.0565	-0.0231	0.0651	2.7557	24	0.9355	-0.0018	-0.3798	-0.1594	0.4403	2.7423
6	0.9415	0.0049	-0.0594	-0.0139	0.0648	2.9159	25	0.9398	-0.0022	-0.3824	-0.1620	0.4419	2.7388
7	0.9469	0.0109	-0.1842	-0.0831	0.2134	2.7288	26	0.9399	0.0053	-0.0546	-0.0202	0.0620	2.7920
8	0.9569	0.0094	-0.1871	-0.0861	0.2153	2.7198	27	0.9377	0.0059	-0.0593	-0.0170	0.0658	2.8684
9	0.9703	0.0151	-0.0597	-0.0167	0.0639	2.8840	28	0.9283	0.0061	-0.0536	-0.0155	0.0601	2.8658
10	0.9748	0.0171	-0.0577	-0.0183	0.0621	2.8512	29	0.9216	0.0065	-0.1061	-0.0530	0.1287	2.6845
11	0.9756	0.0172	-0.0434	-0.0276	0.0527	2.5921	30	0.9186	0.0077	-0.1759	-0.4495	0.5255	1.9515
12	0.9774	0.0174	-0.0588	-0.0319	0.0684	2.6614	31	0.9151	0.0060	-0.1382	-0.0489	0.1602	2.8076
13	0.9801	0.0207	-0.0582	-0.0327	0.0681	2.6506	32	0.9143	0.0056	-0.1934	-0.0696	0.2248	2.8016
14	0.9813	0.0228	-0.1179	-0.0741	0.1420	2.6032	33	0.9141	0.0054	-0.0524	-0.0295	0.0658	2.6346
15	0.9834	0.0245	-0.0585	-0.0094	0.0603	3.0060	34	0.9693	0.0059	0.3562	0.6131	0.7315	-1.0385
16	0.9863	0.0263	-0.0599	-0.0184	0.0635	2.8695	35	0.9897	0.0263	1.2100	0.3422	1.2705	-0.2493
17	0.9923	0.0330	-0.0593	-0.0195	0.0629	2.8572	36	0.9860	0.0190	0.4033	0.2795	0.4977	-0.5871
18	0.9958	0.0351	-0.0899	-0.0390	0.0984	2.7675	37	0.9987	0.0373	0.8067	0.1263	0.8175	-0.1181
19	0.9317	-0.0002	-0.0843	-0.0301	0.0961	2.7989	38	0.9443	-0.0013	0.8067	0.5568	1.0380	-0.6055
w	0.9982												

B.2. Case 2:

Table IV.6: Power Flow solution of CASE38 test system operating in inverse mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9183	0.0000	0.0000	0.0000	0.0000	-0.4636	20	0.9145	-0.0019	-0.0786	-0.0786	0.0918	2.7807
2	0.9183	0.0000	-0.0925	-0.0925	0.1108	2.7106	21	0.9138	-0.0023	-0.0886	-0.0886	0.1002	2.8821
3	0.9199	0.0002	-0.0887	-0.0887	0.0999	2.8749	22	0.9132	-0.0028	-0.0828	-0.0828	0.0956	2.8157
4	0.9216	0.0008	-0.1061	-0.1061	0.1326	2.6233	23	0.9198	-0.0002	-0.0793	-0.0793	0.0955	2.6985
5	0.9237	0.0013	-0.0558	-0.0558	0.0648	2.7708	24	0.9202	-0.0010	-0.3704	-0.3704	0.4346	2.7542
6	0.9289	0.0042	-0.0592	-0.0592	0.0652	2.9320	25	0.9235	-0.0009	-0.3724	-0.3724	0.4358	2.7519
7	0.9348	0.0105	-0.1806	-0.1806	0.2111	2.7374	26	0.9273	0.0046	-0.0535	-0.0535	0.0614	2.7995
8	0.9452	0.0086	-0.1837	-0.1837	0.2131	2.7278	27	0.9252	0.0051	-0.0592	-0.0592	0.0662	2.8877
9	0.9582	0.0086	-0.0595	-0.0595	0.0642	2.8959	28	0.9159	0.0052	-0.0525	-0.0525	0.0596	2.8716
10	0.9635	0.0089	-0.0567	-0.0567	0.0616	2.8493	29	0.9093	0.0055	-0.1040	-0.1040	0.1272	2.6936
11	0.9644	0.0087	-0.0426	-0.0426	0.0520	2.5935	30	0.9064	0.0066	-0.1724	-0.1724	0.5106	1.9591
12	0.9663	0.0083	-0.0581	-0.0581	0.0679	2.6671	31	0.9029	0.0048	-0.1365	-0.1365	0.1597	2.8193
13	0.9700	0.0079	-0.0573	-0.0573	0.0674	2.6462	32	0.9021	0.0044	-0.1910	-0.1910	0.2240	2.8135
14	0.9720	0.0083	-0.1169	-0.1169	0.1409	2.6020	33	0.9019	0.0043	-0.0513	-0.0513	0.0649	2.6442
15	0.9746	0.0085	-0.0577	-0.0577	0.0600	2.9926	34	0.9583	0.0176	0.8334	0.8334	0.8899	-0.1966
16	0.9779	0.0085	-0.0598	-0.0598	0.0637	2.8654	35	0.9762	0.0110	0.7944	0.7944	1.0295	-0.6483
17	0.9859	0.0113	-0.0587	-0.0587	0.0626	2.8391	36	0.9752	0.0122	0.4951	0.4951	0.5495	-0.3808
18	0.9899	0.0117	-0.0898	-0.0898	0.0984	2.7565	37	0.9933	0.0125	0.6698	0.6698	0.7908	-0.5372
19	0.9178	-0.0003	-0.0832	-0.0832	0.0957	2.8136	38	0.9273	0.0003	0.7270	0.7270	0.9002	-0.5137
w	1.0009												

B.3. Case 3:

Table IV.7: Power Flow solution of CASE38 test system operating in mixed mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9026	0.0000	0.0000	0.0000	0.0000	0.0000	20	0.8989	-0.0020	-0.0766	-0.0278	0.0907	2.7911
2	0.9026	0.0000	-0.0910	-0.0397	0.1100	2.7305	21	0.8982	-0.0024	-0.0883	-0.0210	0.1010	2.9055
3	0.9043	0.0003	-0.0884	-0.0219	0.1007	2.8992	22	0.8977	-0.0029	-0.0815	-0.0259	0.0952	2.8314
4	0.9063	0.0006	-0.1034	-0.0572	0.1304	2.6366	23	0.9037	0.0001	-0.0772	-0.0354	0.0940	2.7116
5	0.9086	0.0009	-0.0549	-0.0204	0.0645	2.7874	24	0.9032	-0.0001	-0.3601	-0.1415	0.4284	2.7672
6	0.9147	0.0034	-0.0590	-0.0117	0.0658	2.9491	25	0.9055	0.0006	-0.3615	-0.1427	0.4292	2.7663
7	0.9210	0.0098	-0.1766	-0.0756	0.2086	2.7471	26	0.9131	0.0037	-0.0523	-0.0184	0.0607	2.8078
8	0.9318	0.0076	-0.1798	-0.0786	0.2106	2.7368	27	0.9110	0.0042	-0.0590	-0.0143	0.0666	2.9082
9	0.9455	0.0103	-0.0594	-0.0143	0.0646	2.9159	28	0.9019	0.0041	-0.0513	-0.0141	0.0590	2.8781
10	0.9518	0.0107	-0.0557	-0.0169	0.0611	2.8575	29	0.8955	0.0043	-0.1016	-0.0481	0.1255	2.7037
11	0.9529	0.0104	-0.0418	-0.0255	0.0514	2.6053	30	0.8926	0.0054	-0.1685	-0.4077	0.4942	1.9680
12	0.9551	0.0099	-0.0575	-0.0291	0.0675	2.6835	31	0.8891	0.0036	-0.1346	-0.0435	0.1591	2.8324
13	0.9602	0.0105	-0.0564	-0.0305	0.0668	2.6568	32	0.8884	0.0031	-0.1883	-0.0620	0.2232	2.8267
14	0.9628	0.0115	-0.1159	-0.0686	0.1399	2.6184	33	0.8882	0.0030	-0.0502	-0.0267	0.0640	2.6550
15	0.9659	0.0121	-0.0569	-0.0089	0.0597	2.9989	34	0.9460	0.0100	0.6262	0.4541	0.8177	-0.6174
16	0.9699	0.0126	-0.0597	-0.0167	0.0639	2.8821	35	0.9619	0.0183	0.9277	0.3429	1.0282	-0.3358
17	0.9792	0.0169	-0.0581	-0.0186	0.0623	2.8485	36	0.9643	0.0125	0.4542	0.2593	0.5424	-0.5062
18	0.9839	0.0178	-0.0897	-0.0363	0.0984	2.7752	37	0.9877	0.0190	0.8079	0.4181	0.9210	-0.4585
19	0.9022	-0.0003	-0.0819	-0.0264	0.0953	2.8295	38	0.9086	0.0021	0.6518	0.2620	0.7731	-0.3800
w	0.9991												

B.4. Case 4:

Table IV.8: Power Flow solution of CASE38 test system operating in isochronous mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9244	0.0000	0.0000	0.0000	0.0000	-0.4636	20	0.9206	-0.0018	-0.0794	-0.0302	0.0923	2.7766
2	0.9244	0.0000	-0.0930	-0.0437	0.1112	2.7027	21	0.9199	-0.0023	-0.0887	-0.0242	0.0999	2.8724
3	0.9261	0.0002	-0.0888	-0.0252	0.0996	2.8649	22	0.9193	-0.0027	-0.0833	-0.0285	0.0958	2.8095
4	0.9275	0.0013	-0.1071	-0.0619	0.1334	2.6186	23	0.9263	-0.0009	-0.0802	-0.0385	0.0960	2.6926
5	0.9293	0.0025	-0.0561	-0.0223	0.0650	2.7654	24	0.9276	-0.0032	-0.3750	-0.1549	0.4374	2.7466
6	0.9336	0.0065	-0.0593	-0.0132	0.0650	2.9282	25	0.9319	-0.0045	-0.3776	-0.1574	0.4390	2.7422
7	0.9387	0.0131	-0.1818	-0.0806	0.2118	2.7371	26	0.9320	0.0069	-0.0539	-0.0197	0.0616	2.7988
8	0.9488	0.0122	-0.1848	-0.0836	0.2137	2.7287	27	0.9299	0.0075	-0.0592	-0.0162	0.0660	2.8827
9	0.9624	0.0155	-0.0596	-0.0159	0.0641	2.8964	28	0.9206	0.0076	-0.0530	-0.0151	0.0598	2.8715
10	0.9667	0.0171	-0.0570	-0.0178	0.0618	2.8557	29	0.9139	0.0080	-0.1047	-0.0515	0.1277	2.6923
11	0.9675	0.0172	-0.0428	-0.0268	0.0522	2.5992	30	0.9110	0.0091	-0.1737	-0.4370	0.5162	1.9583
12	0.9692	0.0172	-0.0583	-0.0308	0.0681	2.6721	31	0.9075	0.0074	-0.1372	-0.0473	0.1599	2.8171
13	0.9730	0.0178	-0.0576	-0.0319	0.0676	2.6535	32	0.9067	0.0070	-0.1919	-0.0673	0.2243	2.8112
14	0.9751	0.0187	-0.1172	-0.0722	0.1412	2.6081	33	0.9065	0.0068	-0.0517	-0.0286	0.0652	2.6427
15	0.9776	0.0192	-0.0580	-0.0093	0.0601	3.0024	34	0.9594	0.0166	0.5672	0.2453	0.6441	-0.3915
16	0.9810	0.0197	-0.0598	-0.0178	0.0636	2.8715	35	0.9833	0.0225	1.0936	0.5574	1.2484	-0.4489
17	0.9889	0.0236	-0.0590	-0.0193	0.0628	2.8497	36	0.9755	0.0220	0.4274	0.0629	0.4429	-0.1240
18	0.9930	0.0244	-0.0899	-0.0383	0.0984	2.7627	37	0.9964	0.0255	0.7291	0.3602	0.8162	-0.4334
19	0.9239	-0.0002	-0.0837	-0.0290	0.0959	2.8072	38	0.9365	-0.0041	0.7291	0.6353	1.0326	-0.7209
w	0.9984												

C. CASE69

C.1. Case 1:

Table IV.9: Power Flow solution of CASE69 test system operating in conventional mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9974	0.0000	0.3745	0.2514	0.4522	-0.5913	24	0.9633	-0.0998	-0.0280	-0.0200	0.0357	2.4215	47	0.9970	-0.0001	0.0000	0.0000	0.0000	3.1416
2	0.9974	0.0000	0.0000	0.0000	0.0000	1.5708	25	0.9883	-0.1137	0.4240	0.4335	0.6136	-0.9102	48	0.9924	0.0017	-0.0790	-0.0564	0.0978	2.5233
3	0.9974	0.0000	0.0000	0.0000	0.0000	0.7854	26	0.9876	-0.1135	-0.0140	-0.0100	0.0174	2.4079	49	0.9810	0.0105	-0.3847	-0.2745	0.4817	2.5323
4	0.9972	-0.0002	0.0000	0.0000	0.0000	-2.3562	27	0.9875	-0.1134	-0.0140	-0.0100	0.0174	2.4079	50	0.9833	0.0165	0.4633	-0.0076	0.4713	0.0330
5	0.9954	-0.0016	0.0000	0.0000	0.0000	0.0000	28	0.9979	0.0004	-0.0260	-0.0186	0.0320	2.5210	51	0.9415	-0.0181	-0.0405	-0.0283	0.0525	2.5136
6	0.9718	-0.0086	-0.0026	-0.0022	0.0035	2.4307	29	1.0052	0.0062	0.8220	0.4643	0.9393	-0.5080	52	0.9414	-0.0181	-0.0036	-0.0027	0.0048	2.4800
7	0.9474	-0.0162	-0.0404	-0.0300	0.0531	2.4867	30	1.0040	0.0066	0.0000	0.0000	0.0000	-1.5708	53	0.9367	-0.0223	-0.0043	-0.0035	0.0059	2.4361
8	0.9419	-0.0182	-0.0750	-0.0540	0.0981	2.4994	31	1.0037	0.0067	0.0000	0.0000	0.0000	-0.3588	54	0.9335	-0.0259	-0.0264	-0.0190	0.0348	2.4918
9	0.9395	-0.0193	-0.0300	-0.0220	0.0396	2.4895	32	1.0027	0.0070	0.0000	0.0000	0.0000	1.5708	55	0.9298	-0.0311	-0.0240	-0.0172	0.0318	2.4887
10	0.9155	-0.0204	-0.0280	-0.0190	0.0370	2.5250	33	1.0001	0.0077	-0.0140	-0.0100	0.0172	2.5291	56	0.9268	-0.0364	0.0000	0.0000	0.0000	-1.1071
11	0.9104	-0.0208	-0.1450	-0.1040	0.1960	2.4986	34	0.9967	0.0088	-0.0195	-0.0140	0.0241	2.5277	57	0.9074	-0.0621	0.0000	0.0000	0.0000	0.4636
12	0.9022	-0.0260	-0.1450	-0.1040	0.1978	2.4933	35	0.9961	0.0090	-0.0060	-0.0040	0.0072	2.5626	58	0.8981	-0.0751	0.0000	0.0000	0.0000	2.6779
13	0.9081	-0.0398	-0.0080	-0.0055	0.0107	2.4995	36	0.9972	-0.0001	-0.0260	-0.0186	0.0321	2.5205	59	0.8946	-0.0803	-0.1000	-0.0720	0.1377	2.4373
14	0.9149	-0.0538	-0.0080	-0.0055	0.0106	2.4855	37	0.9955	-0.0013	-0.0260	-0.0186	0.0321	2.5194	60	0.8932	-0.0879	0.3745	1.1678	1.3730	-1.3484
15	0.9228	-0.0680	0.0000	0.0000	0.0000	-1.5708	38	0.9939	-0.0017	0.0000	0.0000	0.0000	-1.5708	61	0.8591	-0.0589	-1.2440	-0.8880	1.7791	2.4627
16	0.9243	-0.0706	-0.0455	-0.0300	0.0590	2.4881	39	0.9934	-0.0018	-0.0240	-0.0170	0.0296	2.5235	62	0.8646	-0.0553	-0.0320	-0.0230	0.0456	2.4631
17	0.9285	-0.0759	-0.0600	-0.0350	0.0748	2.5376	40	0.9934	-0.0018	-0.0240	-0.0170	0.0296	2.5235	63	0.8734	-0.0500	0.0000	0.0000	0.0000	-2.6779
18	0.9286	-0.0760	-0.0600	-0.0350	0.0748	2.5375	41	0.9863	-0.0038	-0.0012	-0.0010	0.0016	2.4431	64	0.9163	-0.0257	-0.2270	-0.1620	0.3043	2.4960
19	0.9355	-0.0813	0.0000	0.0000	0.0000	2.8966	42	0.9833	-0.0046	0.0000	0.0000	0.0000	0.0000	65	1.0020	0.0020	1.2130	0.2244	1.2311	-0.1809
20	0.9399	-0.0847	-0.0010	-0.0006	0.0012	2.5164	43	0.9829	-0.0047	-0.0060	-0.0043	0.0075	2.5151	66	0.9098	-0.0205	-0.0180	-0.0130	0.0244	2.4956
21	0.9471	-0.0902	-0.1140	-0.0810	0.1477	2.4337	44	0.9829	-0.0047	0.0000	0.0000	0.0000	-2.3562	67	0.9098	-0.0205	-0.0180	-0.0130	0.0244	2.4956
22	0.9476	-0.0904	-0.0053	-0.0035	0.0067	2.4675	45	0.9819	-0.0050	-0.0392	-0.0263	0.0481	2.5456	68	0.8986	-0.0248	-0.0280	-0.0200	0.0383	2.4965
23	0.9525	-0.0934	0.0000	0.0000	0.0000	0.0000	46	0.9819	-0.0050	-0.0392	-0.0263	0.0481	2.5456	69	0.8986	-0.0248	-0.0280	-0.0200	0.0383	2.4965
w	0.9981																			

C.2. Case 2:

Table IV.10: Power Flow solution of CASE69 test system operating in inverse mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9974	0.0000	0.4210	0.2577	0.4991	-0.5492	24	0.9633	0.0123	-0.0280	-0.0200	0.0358	2.5336	47	0.9970	-0.0006	0.0000	0.0000	0.0000	1.4828
2	0.9974	0.0000	0.0000	0.0000	0.0000	1.5708	25	0.9883	0.0061	0.4700	0.2918	0.5607	-0.5495	48	0.9924	-0.0079	-0.0790	-0.0564	0.0985	2.5137
3	0.9974	0.0000	0.0000	0.0000	0.0000	1.5516	26	0.9876	0.0063	-0.0140	-0.0100	0.0175	2.5277	49	0.9810	-0.0305	-0.3847	-0.2745	0.4835	2.4913
4	0.9972	-0.0003	0.0000	0.0000	0.0000	-2.0344	27	0.9875	0.0064	-0.0140	-0.0100	0.0175	2.5277	50	0.9833	-0.0334	-0.0932	0.3090	0.3291	-1.8970
5	0.9954	-0.0006	0.0000	0.0000	0.0000	-2.7828	28	0.9979	0.0005	-0.0260	-0.0186	0.0323	2.5211	51	0.9415	0.0132	-0.0405	-0.0283	0.0529	2.5449
6	0.9718	0.0052	-0.0026	-0.0022	0.0035	2.4446	29	1.0052	0.0087	1.0837	0.5649	1.2234	-0.4719	52	0.9414	0.0132	-0.0036	-0.0027	0.0048	2.5113
7	0.9474	0.0116	-0.0404	-0.0300	0.0535	2.5144	30	1.0040	0.0090	0.0000	0.0000	0.0000	3.1416	53	0.9367	0.0154	-0.0043	-0.0035	0.0060	2.4738
8	0.9419	0.0131	-0.0750	-0.0540	0.0989	2.5307	31	1.0037	0.0091	0.0000	0.0000	0.0000	-0.1244	54	0.9335	0.0172	-0.0264	-0.0190	0.0351	2.5350
9	0.9395	0.0138	-0.0300	-0.0220	0.0399	2.5227	32	1.0027	0.0094	0.0000	0.0000	0.0000	-0.3948	55	0.9298	0.0196	-0.0240	-0.0172	0.0319	2.5394
10	0.9155	0.0222	-0.0280	-0.0190	0.0372	2.5676	33	1.0001	0.0102	-0.0140	-0.0100	0.0173	2.5316	56	0.9268	0.0220	0.0000	0.0000	0.0000	1.5708
11	0.9104	0.0240	-0.1450	-0.1040	0.1973	2.5434	34	0.9967	0.0112	-0.0195	-0.0140	0.0242	2.5302	57	0.9074	0.0361	0.0000	0.0000	0.0000	0.0000
12	0.9022	0.0273	-0.1450	-0.1040	0.1990	2.5467	35	0.9961	0.0114	-0.0060	-0.0040	0.0073	2.5650	58	0.8981	0.0432	0.0000	0.0000	0.0000	-0.2450
13	0.9081	0.0258	-0.0080	-0.0055	0.0107	2.5651	36	0.9972	-0.0001	-0.0260	-0.0186	0.0323	2.5205	59	0.8946	0.0460	-0.1000	-0.0720	0.1359	2.5636
14	0.9149	0.0241	-0.0080	-0.0055	0.0107	2.5634	37	0.9955	-0.0013	-0.0260	-0.0186	0.0324	2.5193	60	0.8932	0.0484	1.0226	0.2577	1.1617	-0.1985
15	0.9228	0.0222	0.0000	0.0000	0.0000	-1.5708	38	0.9939	-0.0017	0.0000	0.0000	0.0000	3.1416	61	0.8591	0.0415	-1.2440	-0.8880	1.7599	2.5631
16	0.9243	0.0218	-0.0455	-0.0300	0.0591	2.5805	39	0.9934	-0.0019	-0.0240	-0.0170	0.0299	2.5234	62	0.8646	0.0381	-0.0320	-0.0230	0.0452	2.5565
17	0.9285	0.0208	-0.0600	-0.0350	0.0750	2.6343	40	0.9934	-0.0019	-0.0240	-0.0170	0.0299	2.5234	63	0.8734	0.0330	0.0000	0.0000	0.0000	-0.4636
18	0.9286	0.0208	-0.0600	-0.0350	0.0750	2.6343	41	0.9863	-0.0039	-0.0012	-0.0010	0.0016	2.4430	64	0.9163	0.0092	-0.2270	-0.1620	0.3051	2.5309
19	0.9355	0.0191	0.0000	0.0000	0.0000	3.1416	42	0.9833	-0.0047	0.0000	0.0000	0.0000	0.0000	65	1.0020	-0.0252	0.6967	0.8333	1.1001	-0.8997
20	0.9399	0.0181	-0.0010	-0.0006	0.0012	2.6192	43	0.9829	-0.0048	-0.0060	-0.0043	0.0076	2.5150	66	0.9098	0.0243	-0.0180	-0.0130	0.0246	2.5404
21	0.9471	0.0164	-0.1140	-0.0810	0.1480	2.5402	44	0.9829	-0.0048	0.0000	0.0000	0.0000	-2.5536	67	0.9098	0.0243	-0.0180	-0.0130	0.0246	2.5404
22	0.9476	0.0163	-0.0053	-0.0035	0.0067	2.5742	45	0.9819	-0.0052	-0.0392	-0.0263	0.0485	2.5455	68	0.8986	0.0285	-0.0280	-0.0200	0.0385	2.5498
23	0.9525	0.0150	0.0000	0.0000	0.0000	0.2450	46	0.9819	-0.0052	-0.0392	-0.0263	0.0485	2.5455	69	0.8986	0.0285	-0.0280	-0.0200	0.0385	2.5499
w	1.0013																			

C.3. Case 3:

Table IV.11: Power Flow solution of CASE69 test system operating in mixed mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9775	0.0000	0.3802	0.2699	0.4770	-0.6174	24	0.9450	-0.0210	-0.0280	-0.0200	0.0364	2.5003	47	0.9768	-0.0004	0.0000	0.0000	0.0000	2.4469
2	0.9775	0.0000	0.0000	0.0000	0.0000	3.1416	25	0.9706	-0.0297	0.4566	0.3317	0.5814	-0.6580	48	0.9689	-0.0036	-0.0790	-0.0564	0.1002	2.5180
3	0.9774	0.0000	0.0000	0.0000	0.0000	-1.3141	26	0.9699	-0.0295	-0.0140	-0.0100	0.0177	2.4919	49	0.9463	-0.0122	-0.3847	-0.2745	0.4994	2.5096
4	0.9771	-0.0002	0.0000	0.0000	0.0000	0.5880	27	0.9697	-0.0294	-0.0140	-0.0100	0.0177	2.4919	50	0.9456	-0.0109	0.0622	-0.0773	0.1049	0.8828
5	0.9749	-0.0010	0.0000	0.0000	0.0000	-2.5432	28	0.9782	0.0004	-0.0260	-0.0186	0.0327	2.5211	51	0.9194	0.0038	-0.0405	-0.0283	0.0537	2.5355
6	0.9507	0.0011	-0.0026	-0.0022	0.0036	2.4404	29	0.9904	0.0076	1.0796	0.8373	1.3795	-0.6521	52	0.9192	0.0039	-0.0036	-0.0027	0.0049	2.5020
7	0.9255	0.0033	-0.0404	-0.0300	0.0544	2.5061	30	0.9892	0.0080	0.0000	0.0000	0.0000	0.7854	53	0.9143	0.0041	-0.0043	-0.0035	0.0061	2.4625
8	0.9197	0.0038	-0.0750	-0.0540	0.1005	2.5213	31	0.9889	0.0080	0.0000	0.0000	0.0000	-0.3588	54	0.9110	0.0042	-0.0264	-0.0190	0.0357	2.5220
9	0.9172	0.0039	-0.0300	-0.0220	0.0406	2.5128	32	0.9878	0.0084	0.0000	0.0000	0.0000	0.1244	55	0.9071	0.0043	-0.0240	-0.0172	0.0326	2.5241
10	0.8933	0.0098	-0.0280	-0.0190	0.0379	2.5552	33	0.9852	0.0092	-0.0140	-0.0100	0.0175	2.5305	56	0.9038	0.0043	0.0000	0.0000	0.0000	-0.4636
11	0.8883	0.0111	-0.1450	-0.1040	0.2009	2.5305	34	0.9818	0.0102	-0.0195	-0.0140	0.0244	2.5291	57	0.8868	0.0070	0.0000	0.0000	0.0000	1.5708
12	0.8804	0.0119	-0.1450	-0.1040	0.2027	2.5313	35	0.9811	0.0104	-0.0060	-0.0040	0.0073	2.5640	58	0.8784	0.0084	0.0000	0.0000	0.0000	-1.5708
13	0.8872	0.0067	-0.0080	-0.0055	0.0109	2.5460	36	0.9773	-0.0001	-0.0260	-0.0186	0.0327	2.5205	59	0.8751	0.0090	-0.1000	-0.0720	0.1408	2.5265
14	0.8948	0.0013	-0.0080	-0.0055	0.0108	2.5406	37	0.9755	-0.0013	-0.0260	-0.0186	0.0328	2.5193	60	0.8744	0.0085	0.7331	0.6229	1.1002	-0.6958
15	0.9033	-0.0043	0.0000	0.0000	0.0000	0.0000	38	0.9739	-0.0018	0.0000	0.0000	0.0000	-1.5708	61	0.8355	0.0184	-1.2440	-0.8880	1.8293	2.5400
16	0.9049	-0.0053	-0.0455	-0.0300	0.0602	2.5534	39	0.9734	-0.0019	-0.0240	-0.0170	0.0302	2.5234	62	0.8404	0.0181	-0.0320	-0.0230	0.0469	2.5365
17	0.9093	-0.0077	-0.0600	-0.0350	0.0764	2.6058	40	0.9734	-0.0019	-0.0240	-0.0170	0.0302	2.5234	63	0.8481	0.0177	0.0000	0.0000	0.0000	-3.0861
18	0.9094	-0.0077	-0.0600	-0.0350	0.0764	2.6058	41	0.9661	-0.0039	-0.0012	-0.0010	0.0016	2.4429	64	0.8860	0.0157	-0.2270	-0.1620	0.3148	2.5375
19	0.9165	-0.0105	0.0000	0.0000	0.0000	-1.5708	42	0.9631	-0.0048	0.0000	0.0000	0.0000	1.5708	65	0.9643	0.0097	0.8905	0.5330	1.0763	-0.5296
20	0.9211	-0.0123	-0.0010	-0.0006	0.0013	2.5889	43	0.9627	-0.0049	-0.0060	-0.0043	0.0077	2.5149	66	0.8876	0.0113	-0.0180	-0.0130	0.0250	2.5274
21	0.9285	-0.0151	-0.1140	-0.0810	0.1506	2.5087	44	0.9626	-0.0049	0.0000	0.0000	0.0000	1.7127	67	0.8876	0.0113	-0.0180	-0.0130	0.0250	2.5274
22	0.9290	-0.0153	-0.0053	-0.0035	0.0068	2.5427	45	0.9616	-0.0053	-0.0392	-0.0263	0.0491	2.5454	68	0.8768	0.0132	-0.0280	-0.0200	0.0392	2.5346
23	0.9340	-0.0171	0.0000	0.0000	0.0000	-1.5708	46	0.9616	-0.0053	-0.0392	-0.0263	0.0491	2.5454	69	0.8767	0.0132	-0.0280	-0.0200	0.0392	2.5346
w	0.9994																			

C.4. Case 4:

Table IV.12: Power Flow solution of CASE69 test system operating in isochronous mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$	Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9930	0.0000	0.3632	0.3396	0.5007	-0.7519	24	0.9528	0.1028	-0.0280	-0.0200	0.0361	2.6241	47	0.9925	-0.0001	0.0000	0.0000	0.0000	-1.7726
2	0.9930	0.0000	0.0000	0.0000	0.0000	3.1416	25	0.9781	0.1063	0.5250	0.1138	0.5493	-0.1072	48	0.9882	0.0012	-0.0790	-0.0564	0.0982	2.5228
3	0.9929	0.0000	0.0000	0.0000	0.0000	1.1584	26	0.9774	0.1065	-0.0140	-0.0100	0.0176	2.6279	49	0.9777	0.0083	-0.3847	-0.2745	0.4834	2.5302
4	0.9927	-0.0002	0.0000	0.0000	0.0000	1.8158	27	0.9772	0.1066	-0.0140	-0.0100	0.0176	2.6279	50	0.9803	0.0139	0.4377	0.0229	0.4471	-0.0384
5	0.9903	-0.0010	0.0000	0.0000	0.0000	-1.2315	28	0.9936	0.0003	-0.0260	-0.0186	0.0322	2.5209	51	0.9303	0.0034	-0.0405	-0.0283	0.0531	2.5351
6	0.9641	0.0009	-0.0026	-0.0022	0.0035	2.4402	29	1.0030	0.0051	0.7964	0.6855	1.0477	-0.7056	52	0.9302	0.0034	-0.0036	-0.0027	0.0048	2.5015
7	0.9369	0.0029	-0.0404	-0.0300	0.0537	2.5057	30	1.0017	0.0054	0.0000	0.0000	0.0000	2.8966	53	0.9247	0.0004	-0.0043	-0.0035	0.0060	2.4588
8	0.9307	0.0033	-0.0750	-0.0540	0.0993	2.5209	31	1.0015	0.0055	0.0000	0.0000	0.0000	-0.4636	54	0.9210	-0.0033	-0.0264	-0.0190	0.0353	2.5145
9	0.9279	0.0035	-0.0300	-0.0220	0.0401	2.5123	32	1.0005	0.0058	0.0000	0.0000	0.0000	-0.7854	55	0.9166	-0.0086	-0.0240	-0.0172	0.0322	2.5112
10	0.9033	0.0239	-0.0280	-0.0190	0.0375	2.5693	33	0.9979	0.0066	-0.0140	-0.0100	0.0172	2.5279	56	0.9129	-0.0140	0.0000	0.0000	0.0000	-1.4181
11	0.8982	0.0286	-0.1450	-0.1040	0.1987	2.5480	34	0.9945	0.0076	-0.0195	-0.0140	0.0241	2.5265	57	0.8899	-0.0400	0.0000	0.0000	0.0000	0.7854
12	0.8900	0.0427	-0.1450	-0.1040	0.2005	2.5621	35	0.9938	0.0078	-0.0060	-0.0040	0.0073	2.5614	58	0.8788	-0.0533	0.0000	0.0000	0.0000	0.0000
13	0.8962	0.0570	-0.0080	-0.0055	0.0108	2.5963	36	0.9928	-0.0001	-0.0260	-0.0186	0.0322	2.5205	59	0.8746	-0.0585	-0.1000	-0.0720	0.1409	2.4590
14	0.9034	0.0711	-0.0080	-0.0055	0.0107	2.6104	37	0.9911	-0.0013	-0.0260	-0.0186	0.0323	2.5194	60	0.8724	-0.0663	0.3632	1.3757	1.6309	-1.3790
15	0.9116	0.0848	0.0000	0.0000	0.0000	-1.5708	38	0.9894	-0.0017	0.0000	0.0000	0.0000	1.5708	61	0.8333	-0.0264	-1.2440	-0.8880	1.8342	2.4952
16	0.9132	0.0874	-0.0455	-0.0300	0.0597	2.6461	39	0.9890	-0.0018	-0.0240	-0.0170	0.0297	2.5235	62	0.8383	-0.0207	-0.0320	-0.0230	0.0470	2.4977
17	0.9176	0.0917	-0.0600	-0.0350	0.0757	2.7053	40	0.9890	-0.0018	-0.0240	-0.0170	0.0297	2.5235	63	0.8463	-0.0123	0.0000	0.0000	0.0000	-0.6435
18	0.9176	0.0918	-0.0600	-0.0350	0.0757	2.7053	41	0.9818	-0.0038	-0.0012	-0.0010	0.0016	2.4431	64	0.8861	0.0263	-0.2270	-0.1620	0.3147	2.5481
19	0.9247	0.0948	0.0000	0.0000	0.0000	0.0000	42	0.9789	-0.0046	0.0000	0.0000	0.0000	1.5708	65	0.9691	0.0722	1.2401	0.0235	1.2799	0.0533
20	0.9292	0.0968	-0.0010	-0.0006	0.0013	2.6979	43	0.9785	-0.0047	-0.0060	-0.0043	0.0075	2.5150	66	0.8976	0.0288	-0.0180	-0.0130	0.0247	2.5449
21	0.9365	0.0999	-0.1140	-0.0810	0.1493	2.6237	44	0.9784	-0.0048	0.0000	0.0000	0.0000	-0.4993	67	0.8976	0.0288	-0.0180	-0.0130	0.0247	2.5449
22	0.9370	0.0999	-0.0053	-0.0035	0.0068	2.6579	45	0.9774	-0.0051	-0.0392	-0.0263	0.0483	2.5456	68	0.8864	0.0440	-0.0280	-0.0200	0.0388	2.5653
23	0.9420	0.1008	0.0000	0.0000	0.0000	-3.0703	46	0.9774	-0.0051	-0.0392	-0.0263	0.0483	2.5456	69	0.8864	0.0440	-0.0280	-0.0200	0.0388	2.5654
w	0.9981																			

Chapter-5

A. CASE6

Table IV.13: Power Flow solution of CASE6 test system operating in islanded mode.

Bus	$\|V\|$	$\angle_V$	P	Q	$\|I\|$	$\angle_I$
1	0.9600	0.0000	-0.1487	-0.0984	0.1858	2.5570
2	0.9725	-0.0091	0.0000	0.0000	0.0000	-0.8961
3	0.9639	-0.0466	-0.1993	-0.1409	0.2532	2.4797
4	0.9872	-0.0013	0.1187	0.0587	0.1341	-0.4608
5	0.9901	-0.0078	0.1187	0.0457	0.1284	-0.3751
6	0.9693	-0.0498	0.1187	0.1411	0.1902	-0.9212
w	0.9991					

Chapter-7

A. CASE22

A.1. Without Optimization condition

Table IV.14: Power Flow solution of CASE22 test system in case of without optimization condition.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9868	0.0000	0.0000	0.0000	12	0.9943	0.0057	-0.0163	-0.0195
2	0.9868	0.0000	-0.0168	-0.0209	13	0.9986	0.0064	0.1720	-0.0256
3	0.9866	0.0001	-0.0168	-0.0209	14	0.9959	-0.0018	-0.0347	-0.0301
4	0.9893	-0.0011	-0.0338	-0.0373	15	0.9963	-0.0023	0.0500	0.3364
5	0.9907	-0.0030	0.0602	0.1725	16	0.9950	-0.0008	-0.0803	-0.0701
6	0.9845	0.0000	-0.0105	-0.0142	17	0.9927	0.0039	-0.0496	-0.0478
7	0.9844	0.0001	-0.0088	-0.0117	18	0.9921	0.0041	-0.0496	-0.0478
8	0.9839	0.0003	-0.0144	-0.0186	19	0.9957	0.0102	-0.0438	-0.0389
9	0.9903	0.0033	-0.0193	-0.0259	20	0.9971	0.0115	-0.0373	-0.0360
10	0.9902	0.0033	-0.0144	-0.0186	21	0.9987	0.0121	0.2168	0.0266
11	0.9945	0.0057	-0.0163	-0.0195	22	0.9950	0.0121	-0.0310	-0.0294

A.2. Min of $\mathbf{P}_{loss}$

Table IV.15: Power Flow solution of CASE22 test system in case of minimization of $\mathbf{P}_{loss}$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9936	0.0000	0.0000	0.0000	12	0.9955	-0.0010	-0.0163	-0.0195
2	0.9936	0.0000	-0.0168	-0.0209	13	0.9982	-0.0022	0.0537	0.0629
3	0.9935	0.0001	-0.0168	-0.0209	14	0.9975	-0.0023	-0.0347	-0.0301
4	0.9961	-0.0011	-0.0338	-0.0373	15	0.9980	-0.0024	0.1815	0.1684
5	0.9984	-0.0020	0.1212	0.1473	16	0.9965	-0.0020	-0.0803	-0.0701
6	0.9922	0.0009	-0.0105	-0.0142	17	0.9936	-0.0011	-0.0496	-0.0478
7	0.9921	0.0010	-0.0088	-0.0117	18	0.9930	-0.0010	-0.0496	-0.0478
8	0.9916	0.0012	-0.0144	-0.0186	19	0.9955	-0.0017	-0.0438	-0.0389
9	0.9942	-0.0003	-0.0193	-0.0259	20	0.9966	-0.0020	-0.0373	-0.0360
10	0.9941	-0.0002	-0.0144	-0.0186	21	0.9981	-0.0024	0.1396	0.1298
11	0.9956	-0.0011	-0.0163	-0.0195	22	0.9946	-0.0014	-0.0310	-0.0294

A.3. Min of $\mathbf{Q}_{loss}$

Table IV.16: Power Flow solution of CASE22 test system in case of minimization of $\mathbf{Q}_{loss}$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9937	0.0000	0.0000	0.0000	12	0.9956	-0.0009	-0.0163	-0.0195
2	0.9937	0.0000	-0.0168	-0.0209	13	0.9982	-0.0021	0.0532	0.0637
3	0.9936	0.0001	-0.0168	-0.0209	14	0.9975	-0.0020	-0.0347	-0.0301
4	0.9962	-0.0011	-0.0338	-0.0373	15	0.9980	-0.0021	0.1825	0.1662
5	0.9984	-0.0021	0.1207	0.1482	16	0.9965	-0.0017	-0.0803	-0.0701
6	0.9922	0.0009	-0.0105	-0.0142	17	0.9936	-0.0008	-0.0496	-0.0478
7	0.9922	0.0010	-0.0088	-0.0117	18	0.9931	-0.0006	-0.0496	-0.0478
8	0.9917	0.0012	-0.0144	-0.0186	19	0.9955	-0.0014	-0.0438	-0.0389
9	0.9943	-0.0002	-0.0193	-0.0259	20	0.9967	-0.0017	-0.0373	-0.0360
10	0.9941	-0.0002	-0.0144	-0.0186	21	0.9981	-0.0021	0.1394	0.1303
11	0.9957	-0.0009	-0.0163	-0.0195	22	0.9946	-0.0011	-0.0310	-0.0294

A.3. Min of $(0.5 * \mathbf{P}_{loss} + 0.5 * \mathbf{Q}_{loss})$

Table IV.17: Power Flow solution of CASE22 test system in case of minimization of $(0.5 * \mathbf{P}_{loss} + 0.5 * \mathbf{Q}_{loss})$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9936	0.0000	0.0000	0.0000	12	0.9955	-0.0005	-0.0163	-0.0195
2	0.9936	0.0000	-0.0168	-0.0209	13	0.9982	-0.0016	0.0518	0.0649
3	0.9935	0.0001	-0.0168	-0.0209	14	0.9976	-0.0010	-0.0347	-0.0301
4	0.9961	-0.0011	-0.0338	-0.0373	15	0.9981	-0.0011	0.1849	0.1638
5	0.9983	-0.0021	0.1193	0.1507	16	0.9965	-0.0007	-0.0803	-0.0701
6	0.9921	0.0009	-0.0105	-0.0142	17	0.9936	0.0002	-0.0496	-0.0478
7	0.9921	0.0009	-0.0088	-0.0117	18	0.9931	0.0004	-0.0496	-0.0478
8	0.9915	0.0011	-0.0144	-0.0186	19	0.9955	-0.0003	-0.0438	-0.0389
9	0.9942	0.0000	-0.0193	-0.0259	20	0.9966	-0.0006	-0.0373	-0.0360
10	0.9941	0.0000	-0.0144	-0.0186	21	0.9981	-0.0010	0.1398	0.1289
11	0.9956	-0.0005	-0.0163	-0.0195	22	0.9946	0.0000	-0.0310	-0.0294

B. CASE38

B.1. Without Optimization condition

Table IV.18: Power Flow solution of CASE38 test system in without optimization condition.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9322	0.0000	0.0000	0.0000	20	0.9284	-0.0018	-0.0804	-0.0311
2	0.9322	0.0000	-0.0937	-0.0452	21	0.9278	-0.0022	-0.0888	-0.0255
3	0.9339	0.0002	-0.0889	-0.0265	22	0.9272	-0.0026	-0.0840	-0.0295
4	0.9353	0.0010	-0.1085	-0.0637	23	0.9342	-0.0005	-0.0812	-0.0397
5	0.9371	0.0017	-0.0565	-0.0231	24	0.9355	-0.0018	-0.3798	-0.1594
6	0.9415	0.0049	-0.0594	-0.0139	25	0.9398	-0.0022	-0.3824	-0.1620
7	0.9469	0.0109	-0.1842	-0.0831	26	0.9399	0.0053	-0.0546	-0.0202
8	0.9569	0.0094	-0.1871	-0.0861	27	0.9377	0.0059	-0.0593	-0.0170
9	0.9703	0.0151	-0.0597	-0.0167	28	0.9283	0.0061	-0.0536	-0.0155
10	0.9748	0.0171	-0.0577	-0.0183	29	0.9216	0.0065	-0.1061	-0.0530
11	0.9756	0.0172	-0.0434	-0.0276	30	0.9186	0.0077	-0.1759	-0.4495
12	0.9774	0.0174	-0.0588	-0.0319	31	0.9151	0.0060	-0.1382	-0.0489
13	0.9801	0.0207	-0.0582	-0.0327	32	0.9143	0.0056	-0.1934	-0.0696
14	0.9813	0.0228	-0.1179	-0.0741	33	0.9141	0.0054	-0.0524	-0.0295
15	0.9834	0.0245	-0.0585	-0.0094	34	0.9693	0.0059	0.3562	0.6131
16	0.9863	0.0263	-0.0599	-0.0184	35	0.9897	0.0263	1.2100	0.3422
17	0.9923	0.0330	-0.0593	-0.0195	36	0.9860	0.0190	0.4033	0.2795
18	0.9958	0.0351	-0.0899	-0.0390	37	0.9987	0.0373	0.8067	0.1263
19	0.9317	-0.0002	-0.0843	-0.0301	38	0.9443	-0.0013	0.8067	0.5568

B.2. Min of $\mathbf{P}_{loss}$

Table IV.19: Power Flow solution of CASE38 test system in case of minimization of $\mathbf{P}_{loss}$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9434	0.0000	0.0000	0.0000	20	0.9396	-0.0016	-0.0819	-0.0324
2	0.9434	0.0000	-0.0948	-0.0474	21	0.9389	-0.0021	-0.0890	-0.0274
3	0.9451	0.0002	-0.0891	-0.0285	22	0.9383	-0.0024	-0.0849	-0.0309
4	0.9448	0.0004	-0.1101	-0.0659	23	0.9475	0.0004	-0.0830	-0.0416
5	0.9448	0.0006	-0.0569	-0.0239	24	0.9532	0.0014	-0.3907	-0.1699
6	0.9452	0.0013	-0.0594	-0.0143	25	0.9619	0.0031	-0.3961	-0.1753
7	0.9492	0.0046	-0.1849	-0.0838	26	0.9435	0.0017	-0.0550	-0.0205
8	0.9560	0.0026	-0.1869	-0.0858	27	0.9414	0.0023	-0.0594	-0.0174
9	0.9625	0.0024	-0.0596	-0.0159	28	0.9320	0.0027	-0.0539	-0.0157
10	0.9649	0.0018	-0.0568	-0.0177	29	0.9253	0.0032	-0.1067	-0.0538
11	0.9653	0.0016	-0.0427	-0.0266	30	0.9224	0.0045	-0.1770	-0.4558
12	0.9662	0.0011	-0.0581	-0.0305	31	0.9188	0.0029	-0.1388	-0.0497
13	0.9662	0.0004	-0.0570	-0.0311	32	0.9181	0.0024	-0.1941	-0.0708
14	0.9666	0.0002	-0.1163	-0.0697	33	0.9179	0.0023	-0.0527	-0.0299
15	0.9676	0.0001	-0.0571	-0.0089	34	0.9713	0.0073	0.7831	0.4193
16	0.9691	0.0000	-0.0597	-0.0166	35	0.9724	0.0053	0.5042	0.2758
17	0.9730	0.0014	-0.0576	-0.0182	36	0.9744	0.0028	0.3889	0.2564
18	0.9752	0.0016	-0.0896	-0.0344	37	0.9772	0.0021	0.4033	0.2280
19	0.9429	-0.0002	-0.0853	-0.0315	38	0.9690	0.0055	1.4894	0.7325

B.3. Min of $\mathbf{Q}_{loss}$

Table IV.20: Power Flow solution of CASE38 test system in case of minimization of $\mathbf{Q}_{loss}$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9428	0.0000	0.0000	0.0000	20	0.9390	-0.0016	-0.0818	-0.0323
2	0.9428	0.0000	-0.0947	-0.0473	21	0.9384	-0.0020	-0.0890	-0.0273
3	0.9445	0.0001	-0.0891	-0.0284	22	0.9378	-0.0024	-0.0848	-0.0309
4	0.9441	0.0004	-0.1100	-0.0658	23	0.9470	0.0003	-0.0829	-0.0416
5	0.9441	0.0007	-0.0569	-0.0238	24	0.9530	0.0011	-0.3905	-0.1698
6	0.9442	0.0015	-0.0594	-0.0142	25	0.9619	0.0026	-0.3961	-0.1752
7	0.9480	0.0047	-0.1845	-0.0834	26	0.9426	0.0019	-0.0549	-0.0204
8	0.9547	0.0028	-0.1865	-0.0854	27	0.9404	0.0025	-0.0593	-0.0173
9	0.9614	0.0027	-0.0596	-0.0158	28	0.9312	0.0030	-0.0539	-0.0157
10	0.9643	0.0026	-0.0568	-0.0177	29	0.9246	0.0036	-0.1066	-0.0536
11	0.9648	0.0024	-0.0426	-0.0266	30	0.9216	0.0048	-0.1768	-0.4546
12	0.9660	0.0021	-0.0581	-0.0304	31	0.9181	0.0033	-0.1387	-0.0496
13	0.9663	0.0018	-0.0570	-0.0311	32	0.9174	0.0029	-0.1940	-0.0706
14	0.9668	0.0018	-0.1163	-0.0698	33	0.9171	0.0028	-0.0527	-0.0298
15	0.9679	0.0018	-0.0571	-0.0090	34	0.9686	0.0070	0.7203	0.3785
16	0.9695	0.0019	-0.0597	-0.0166	35	0.9707	0.0045	0.4478	0.2926
17	0.9737	0.0037	-0.0576	-0.0183	36	0.9747	0.0044	0.4451	0.2526
18	0.9760	0.0041	-0.0896	-0.0346	37	0.9781	0.0048	0.4451	0.2191
19	0.9423	-0.0002	-0.0852	-0.0315	38	0.9691	0.0048	1.5089	0.7639

B.4. Min of $(0.5 * \mathbf{P}_{loss} + 0.5 * \mathbf{Q}_{loss})$

Table IV.21: Power Flow solution of CASE38 test system in case of minimization of $(0.5 * \mathbf{P}_{loss} + 0.5 * \mathbf{Q}_{loss})$.

Bus	$\|V\|$	$\angle_V$	P	Q	Bus	$\|V\|$	$\angle_V$	P	Q
1	0.9428	0.0000	0.0000	0.0000	20	0.9390	-0.0016	-0.0818	-0.0323
2	0.9428	0.0000	-0.0947	-0.0473	21	0.9383	-0.0020	-0.0890	-0.0273
3	0.9445	0.0001	-0.0891	-0.0284	22	0.9377	-0.0024	-0.0848	-0.0309
4	0.9441	0.0004	-0.1100	-0.0658	23	0.9469	0.0003	-0.0829	-0.0415
5	0.9441	0.0006	-0.0569	-0.0238	24	0.9527	0.0012	-0.3904	-0.1696
6	0.9444	0.0013	-0.0594	-0.0142	25	0.9615	0.0028	-0.3958	-0.1750
7	0.9483	0.0046	-0.1846	-0.0835	26	0.9428	0.0018	-0.0549	-0.0205
8	0.9550	0.0026	-0.1866	-0.0855	27	0.9406	0.0024	-0.0593	-0.0173
9	0.9617	0.0024	-0.0596	-0.0158	28	0.9313	0.0029	-0.0539	-0.0157
10	0.9644	0.0020	-0.0568	-0.0177	29	0.9247	0.0035	-0.1066	-0.0536
11	0.9648	0.0018	-0.0426	-0.0266	30	0.9218	0.0047	-0.1769	-0.4548
12	0.9659	0.0014	-0.0581	-0.0304	31	0.9183	0.0031	-0.1387	-0.0496
13	0.9660	0.0008	-0.0569	-0.0311	32	0.9175	0.0027	-0.1940	-0.0706
14	0.9665	0.0007	-0.1163	-0.0697	33	0.9173	0.0026	-0.0527	-0.0298
15	0.9675	0.0007	-0.0571	-0.0089	34	0.9694	0.0068	0.7402	0.3948
16	0.9691	0.0007	-0.0597	-0.0166	35	0.9714	0.0048	0.4852	0.2856
17	0.9731	0.0022	-0.0576	-0.0182	36	0.9744	0.0034	0.4212	0.2562
18	0.9753	0.0024	-0.0896	-0.0344	37	0.9774	0.0030	0.4212	0.2262
19	0.9423	-0.0002	-0.0852	-0.0315	38	0.9686	0.0051	1.4989	0.7438