Prepared by;
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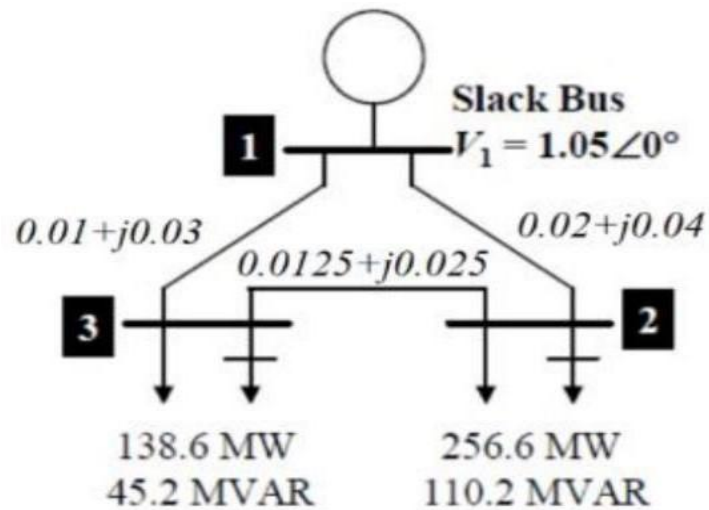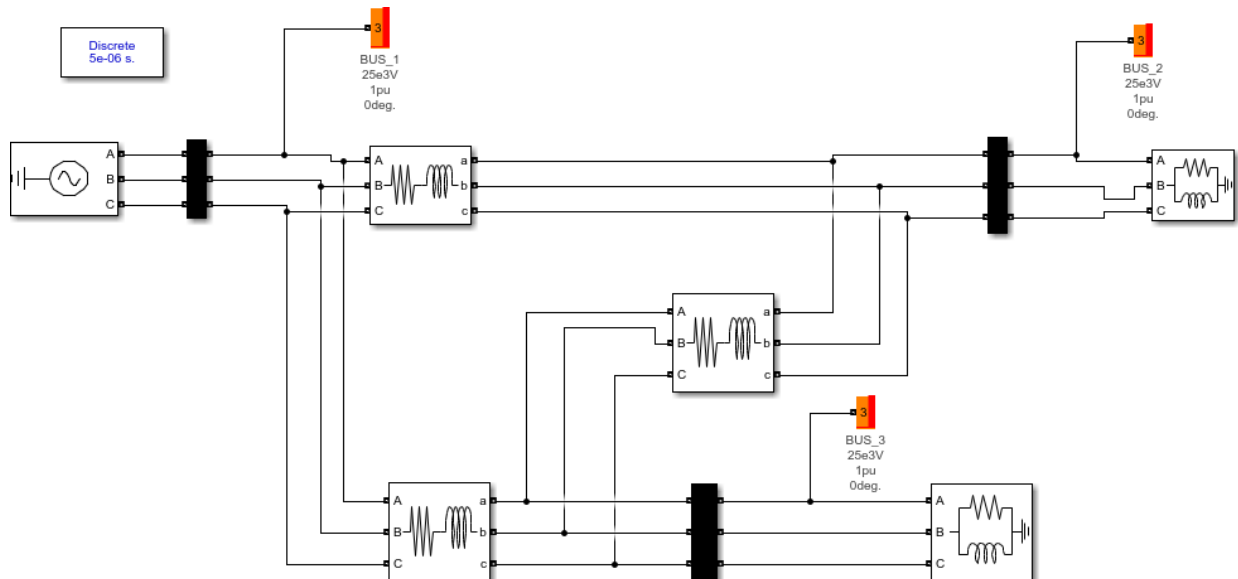
3 Bus Systems

Modeling in Simulink

Figure 1 Simulink Model

The above is solved in MATLAB Simulink. Three buses are represented by the VI-measurement block which is represented as black block in above figure. One is source(slack bus) which is taken as reference bus having swing voltage of 1.05 <0^0. Three phase source is used in Simulink to supply given voltage level. The other two bus are load bus. Three phase parallel RLC load is used to represent the load bus in Simulink. The impedance between the buses are represented by Parallel RLC branch. The power flow between the buses and their voltage level is further calculated using powergui load flow tool.

Analysis
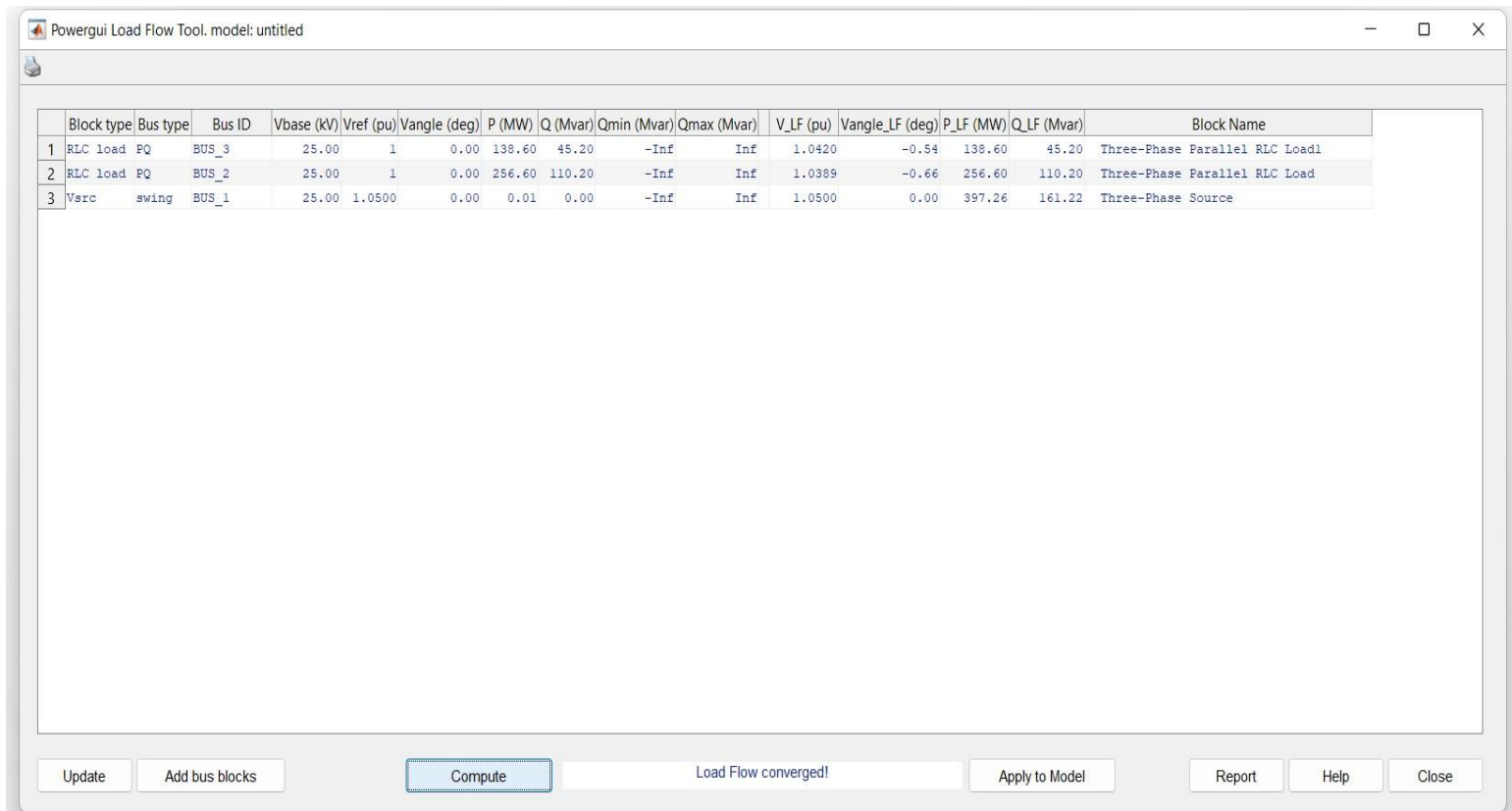
Using Load Flow Analysis, following result is obtained:

	Block type	Bus type	Bus ID	Vbase (kV)	Vref (pu)	Vangle (deg)	P (MW)	Q (Mvar)	Qmin (Mvar)	Qmax (Mvar)	V_LF (pu)	Vangle_LF (deg)	P_LF (MW)	Q_LF (Mvar)	Block Name
1	RLC load	PQ	BUS_3	25.00	1	0.00	138.60	45.20	-Inf	Inf	1.0420	-0.54	138.60	45.20	Three-Phase Parallel RLC Load1
2	RLC load	PQ	BUS_2	25.00	1	0.00	256.60	110.20	-Inf	Inf	1.0389	-0.66	256.60	110.20	Three-Phase Parallel RLC Load
3	Vsrc	swing	BUS_1	25.00	1.0500	0.00	0.01	0.00	-Inf	Inf	1.0500	0.00	397.26	161.22	Three-Phase Source

Figure 2 Load Flow Analysis

In modeling base voltage is taken as 25KV. The slack bus voltage or reference voltage is 1.05<0 pu. The real and reactive power of load bus as rated is supplied there.

It is obtained that the voltage level at bus 2 is 1.038<-0.660. Similarly the voltage level at bus 3 is 1.04<-0.540. The total real power supplied is 397.26 MW and reactive power supplied is 161.22Mvar.

Moreover, the power obtained at bus 2 is 256.6 Mw and 110.20 Mvar. The real and reactive power at bus 3 is 138.6 Mw and 45.2 Mvar respectively.

In further detail, the data can be exported to matlab editor window through report option.

Figure 3 Reporting the data in editor window

Here, the total power generation is 397.26 Mw and 161.22 Mvar. Similarly, the total PQ load is 395.20 MW and 155.40 Mvar. So, the losses is 2.06 Mw and 5.82 Mvar. The power supplied by bus 1 to bus 2 is 193.52 Mw and 72.01 Mvar and to bus 3 is 203.74 Mw and 89.21 Mvar.

The power received by bus 2 through bus 1 is 192.28 Mw and 69.03 Mvar and power received by bus 2 through bus 3 is 64.32 Mw and 41.17 Mvar. Similarly, the power flow from bus 1 to bus 3 is 203.74Mw and 89.21 Mvar.

With Slack, PQ and PV Bus
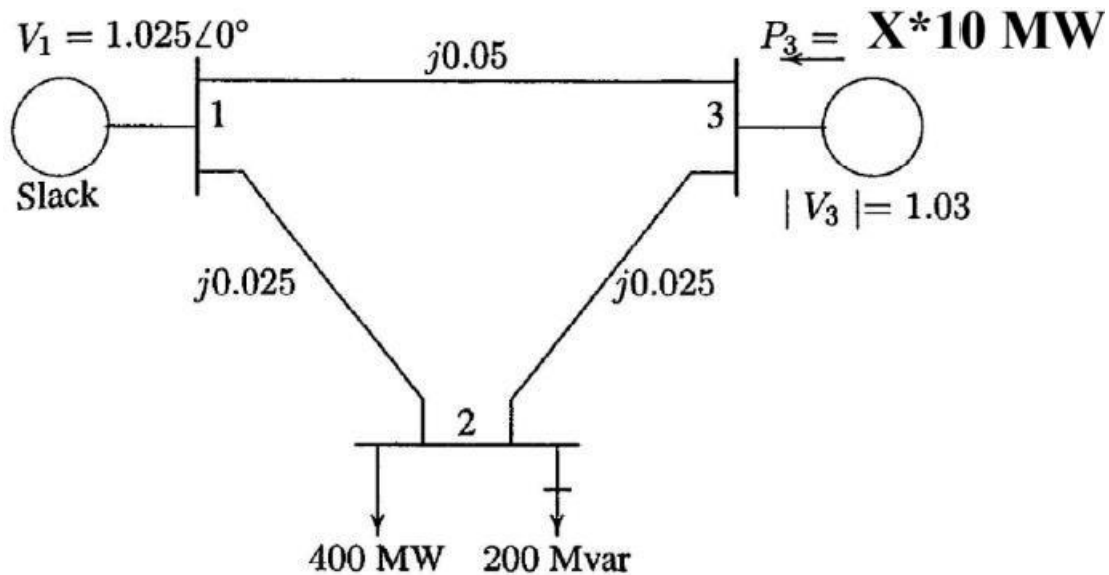
Perform load flow on the network shown below using Matlab/Simulink. The real power injection at bus 3 is ten times your class roll number. From the results of the load flow solution, calculate the line flows and losses in the lines and the apparent power at the slack bus. Please note that the impedances are marked in pu on a 100 MVA base.

Modeling the above question in Simulink
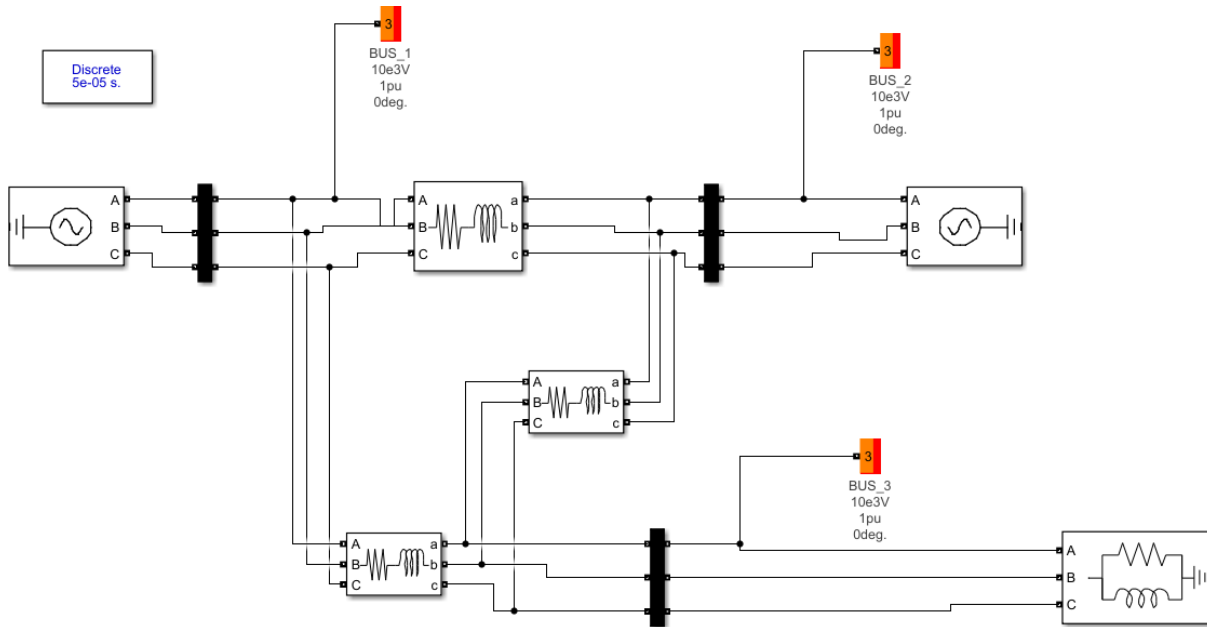
Figure 4 Simulink Model

The above is solved in MATLAB Simulink. Three buses are represented by the VI-measurement block which is represented as black block in above figure. One is source(slack bus) which is taken as reference bus having swing voltage of 1.025 <00. Another is PV bus having a voltage 1.03 <00. Three phase source is used in Simulink to supply given voltage level. The other bus is load bus. Three phase parallel RLC load is used to represent the load bus in Simulink. The impedance between the buses are represented by Parallel RLC branch. The power flow between the buses and their voltage level is further calculated using powergui load flow tool.

Analysis

The flowing result is obtained using load flow analysis

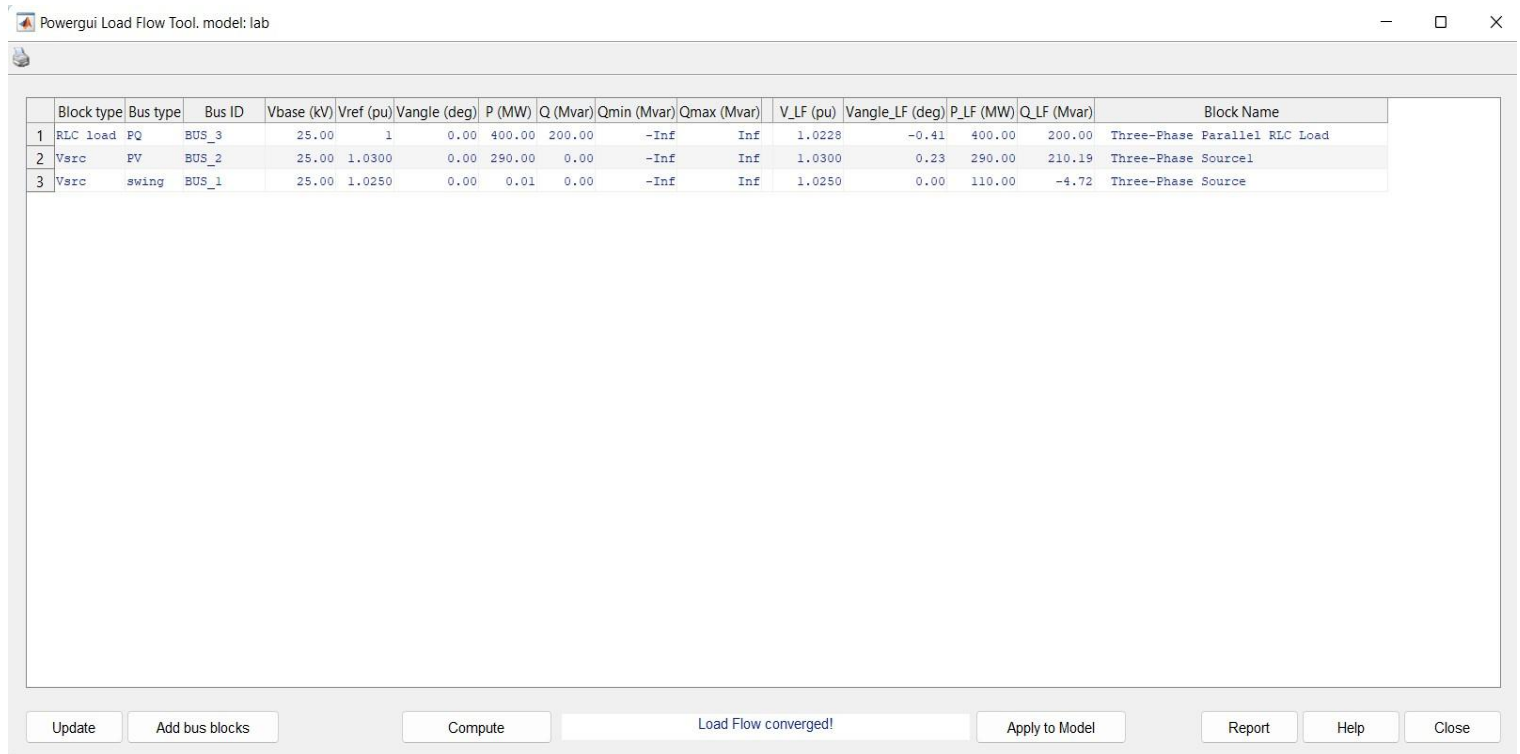|	Block type	Bus type	Bus ID	Vbase (kV)	Vref (pu)	Vangle (deg)	P (MW)	Q (Mvar)	Qmin (Mvar)	Qmax (Mvar)	V_LF (pu)	Vangle_LF (deg)	P_LF (MW)	Q_LF (Mvar)	Block Name
1	RLC load	PQ	BUS_3	25.00	1	0.00	400.00	200.00	-Inf	Inf	1.0228	-0.41	400.00	200.00	Three-Phase Parallel RLC Load
2	Vsrc	PV	BUS_2	25.00	1.0300	0.00	290.00	0.00	-Inf	Inf	1.0300	0.23	290.00	210.19	Three-Phase Source1
3	Vsrc	swing	BUS_1	25.00	1.0250	0.00	0.01	0.00	-Inf	Inf	1.0250	0.00	110.00	-4.72	Three-Phase Source

Update   Add bus blocks   Compute   Load Flow converged!   Apply to Model   Report   Help   Close

Figure 5 Load flow analysis

In modeling base voltage is taken as 25KV. The slack bus voltage or reference voltage is $1.025<0$ pu. The another PV bus has voltage $1.03<0^0$. The voltage level obtained at PQ bus is $1.0228<-0.41^0$ .The real and reactive power of load bus as rated is supplied there.

In further detail, the data can be exported to matlab editor window through report option.

Editor - C:\Users\acer\Desktop\BS lab\LoadFlow1.rep

EDITOR   VIEW

New   Open   Save   Find Files   Compare ▾   Go To ▾   Find ▾   Insert   Comment   Indent   Breakpoints

FILE   NAVIGATE   EDIT   BREAKPOINTS

LoadFlow1.rep

```
 3
 4
 5
 6    SUMMARY for subnetwork No 1
 7
 8      Total generation   : P=     400.00 MW Q=     205.47 Mvar
 9      Total PQ load      : P=     400.00 MW Q=     200.00 Mvar
10      Total Zshunt load  : P=       0.00 MW Q=      -0.00 Mvar
11      Total ASM load     : P=       0.00 MW Q=       0.00 Mvar
12      Total losses       : P=       0.00 MW Q=       5.47 Mvar
13
14
15   1 : BUS_1   V= 1.025 pu/25kV 0.00 deg   ; Swing bus
16          Generation : P=  110.00 MW Q=    -4.72 Mvar
17          PQ_load    : P=    0.00 MW Q=     0.00 Mvar
18          Z_shunt    : P=    0.00 MW Q=    -0.00 Mvar
19      -->  BUS_2     : P=  -44.72 MW Q=   -53.01 Mvar
20      -->  BUS_3     : P=  154.72 MW Q=    48.29 Mvar
21
22   2 : BUS_2   V= 1.030 pu/25kV 0.23 deg
23          Generation : P=  290.00 MW Q=   210.19 Mvar
24          PQ_load    : P=    0.00 MW Q=     0.00 Mvar
25          Z_shunt    : P=    0.00 MW Q=    -0.00 Mvar
26      -->  BUS_1     : P=   44.72 MW Q=    53.45 Mvar
27      -->  BUS_3     : P=  245.28 MW Q=   156.74 Mvar
28
29   3 : BUS_3   V= 1.023 pu/25kV -0.41 deg
30          Generation : P=    0.00 MW Q=     0.00 Mvar
31          PQ_load    : P=  400.00 MW Q=   200.00 Mvar
32          Z_shunt    : P=   -0.00 MW Q=     0.00 Mvar
33      -->  BUS_1     : P= -154.72 MW Q=   -47.09 Mvar
34      -->  BUS_2     : P= -245.28 MW Q=  -152.91 Mvar
35
```

Figure 6 Reporting the data in editor window

Here,two buses are generating bus. The total generation capacity is 400 Mw and 205.47 Mvar. The total PQ load is 400 Mw and 200 Mvar. So, the losses is 5.47 Mvar.

Here, the power flow from bus 2 to bus 1 is 44.72 Mw and 53.01 Mvar. Similarly, from Bus 1 to Bus 3 is 154.72 Mw and 48.29 Mvar. Furthermore, the power flow from bus 2 to bus 3 is 245.28 Mw and 456.74 Mvar.