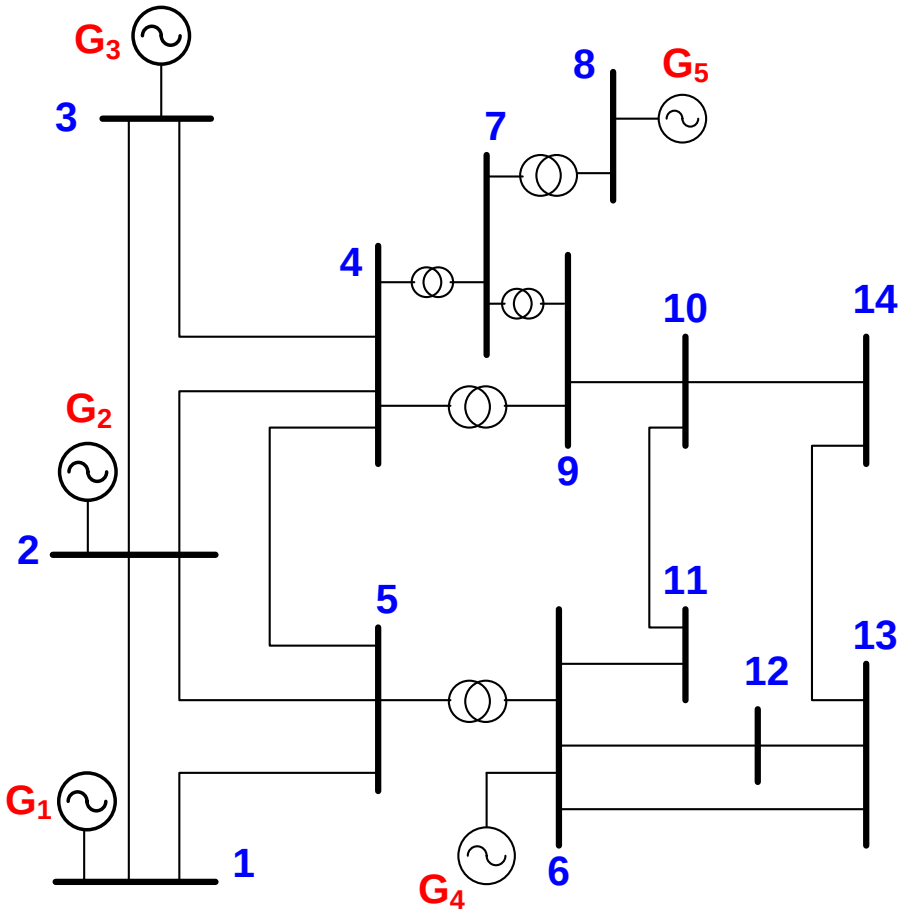
KIE4005- Individual Assignment

The IEEE 14-bus test system is given below:



System Data (line data are given in p.u., based on 100 MVA base)

From node	To node	R	X	B	Distance (km)	Fault /100 km/year
1	2	0.019	0.059	0.053	12	1
1	5	0.054	0.223	0.049	35	3
2	3	0.047	0.198	0.044	20	1
2	4	0.058	0.176	0.034	18	2
2	5	0.057	0.174	0.035	23	0
3	4	0.067	0.171	0.013	20	2
4	5	0.013	0.042	0.020	5	1
4	7	0	0.209	0	0	0
4	9	0	0.556	0	0	0
5	6	0	0.252	0	0	0
6	11	0.095	0.200	0	24	2
6	12	0.123	0.256	0	60	5
6	13	0.066	0.130	0	25	2

7	8	0	0.176	0	0	0
7	9	0	0.110	0	0	0
9	10	0.032	0.085	0	15	1
10	14	0.127	0.270	0	22	2
10	11	0.082	0.192	0	17	1
12	13	0.221	0.200	0	21	2
13	14	0.171	0.348	0	30	3

1. The three-phase short circuit event, in the 5 events listed below, is designated per 100 km per year.

2. Line charging (B), given in p.u., must be considered in the calculation of the Y-bus admittance matrix. The sub-transient reactance (X") of the generators are given in the table below, based on the generator's capacity:

Generator	X"	Capacity Unit
1	14 %	250 MVA
2	12 %	100 MVA
3	10 %	80 MVA
4	8 %	50 MVA
5	6 %	50 MVA

Question

1. Calculate the voltage sag at bus 5 and bus 14 when a three-phase-fault occurs at each bus in the system. The pre-fault voltage, in per unit, of all buses are given below:

Bus	Voltage (p.u.)	Angle (Degree)
1	1.06	0
2	1.045	-4.96
3	1.01	-12.69
4	1.018	-10.29
5	1.02	-8.76
6	1.07	-14.20
7	1.062	-13.34
8	1.09	-13.34
9	1.056	-14.92
10	1.051	-15.08
11	1.057	-14.77
12	1.055	-15.05
13	1.05	-15.13
14	1.036	-16.01

2. Repeat Question 1, but with the following condition:

(a) Line 2 – 4 and line 6 – 13 are open-circuited.

(b) Generator G_3 at bus 3 and G_5 at bus 8 are deactivated.

From the results, discuss your observations.

3. Using the original system conditions as in Question 1, estimate voltage event under 40% of the nominal 1.0 p.u. for bus 5 and 14 using the given short circuit event per year. (***Note: Estimation of voltage sag on a line can be calculated as the average of voltage sag between 2 connected buses***).

4. Based on the analysis in Question 3, plot a bar chart highlighting the number of voltage sags at bus 4 and 13 according to the sag magnitude level, as illustrated in the following table (% nominal 1.0 p.u.).

Vsag (%)	10%-20 %	20 % - 30 %	30 % - 40 %	40 % - 50 %	50 % - 60 %	60 % - 70 %	70 % - 80 %	80 % - 90 %	90 % - 100 %
Number of sag									

5. Based on the result of Question 3 and 4, discuss the suitable place (either bus 5 or 14) to place a factory manufacturing electronic component.

6. Suggest how to improve the voltage at bus 5 or 14, when there is fault at any location in the system. Justify your suggestion with analytical results.

You MUST write a program code to solve the assignment problems. The program should be able to display the voltage sag, when a three fault occurs at any bus. You are required to use MATLAB to do the analysis.

Write a report to present your analysis results and discussion. The report will be assessed for 20% of the overall course marks. **There is no specific format for the report. However, <u>the report should NOT exceed 20 pages</u>. Use pictorial illustrations, bar charts, innovative graphics to illustrate your results, rather than simple table listing. Attach your MATLAB codes to the zipped file.**

The report should encompass the following aspects:

1	Voltage sag calculations under different operating conditions.	5 %
2	Analysis and discussion of voltage sag results analytically and graphically.	5 %
3	Suggestion and demonstration of a viable solution to mitigate voltage sag occurrence in the system.	5 %
4	Provision of a MATLAB code displaying voltage sag results in all cases.	5 %