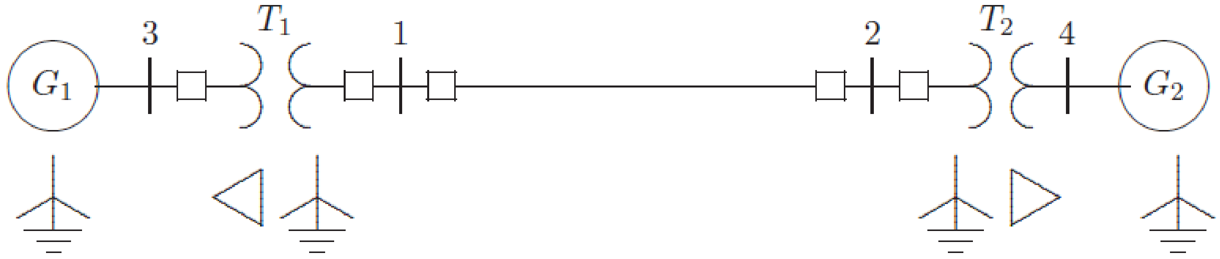
HW

Q1/ The reactance data for the power system shown in Figur in per unit on a common base is as follows:



Item	X^1	X^2	X^0
G_1	0.10	0.10	0.05
G_2	0.10	0.10	0.05
T_1	0.25	0.25	0.25
T_2	0.25	0.25	0.25
Line 1–2	0.30	0.30	0.50

Obtain the Th´evenin sequence impedances for the fault at bus 1 and compute the fault current in per unit for the following faults:

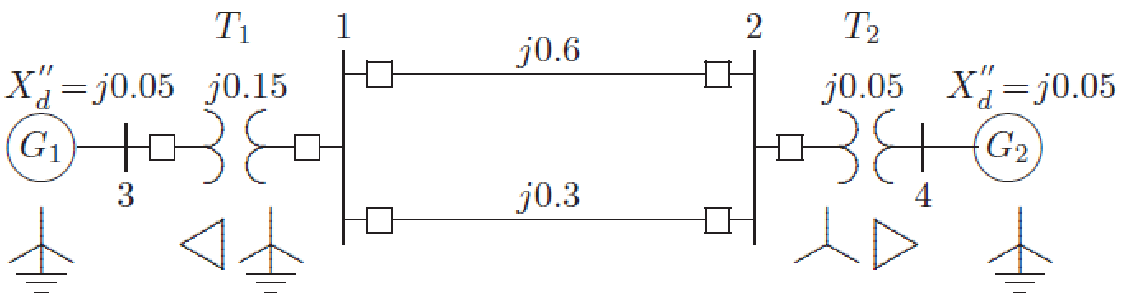
(a) A bolted three-phase fault at bus 1.

(b) A bolted single line-to-ground fault at bus 1.

(c) A bolted line-to-line fault at bus 1.

(d) A bolted double line-to-ground fault at bus 1.

Q2/The positive-sequence reactances for the power system shown in Figure are in per unit on a common MVA base. Resistances are neglected and the negative-sequence impedances are assumed to be the same as the positive-sequence impedances. A bolted line-to-line fault occurs between phases *b* and *c* at bus 2. Before the fault occurrence, all bus voltages are 1.0 per unit. Obtain the positive sequence bus impedance matrix. Find the fault current, the three-phase bus voltages during fault, and the line currents in each phase.



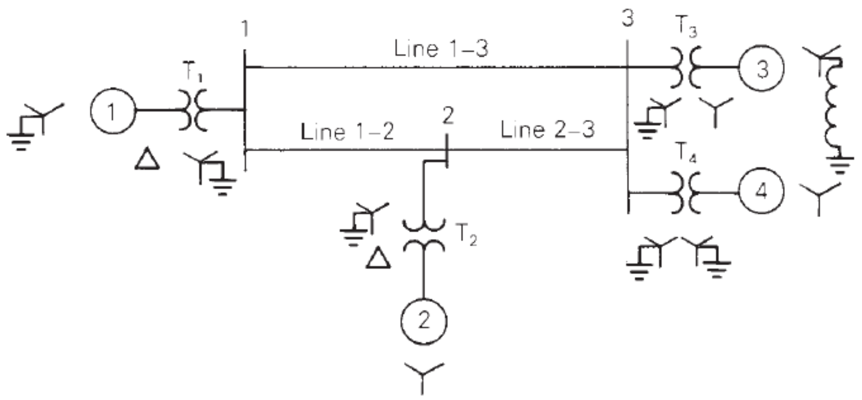
Q3/ The single-line diagram of a three-phase power system is shown in Figure. Equipment ratings are given as follows:

Synchronous generators:

G1	1000 MVA	15 kV	$X''_d = X_2 = 0.18, X_0 = 0.07$ per unit
G2	1000 MVA	15 kV	$X''_d = X_2 = 0.20, X_0 = 0.10$ per unit
G3	500 MVA	13.8 kV	$X''_d = X_2 = 0.15, X_0 = 0.05$ per unit
G4	750 MVA	13.8 kV	$X''_d = 0.30, X_2 = 0.40, X_0 = 0.10$ per unit

Transformers:

T1	1000 MVA	15 kV Δ/765 kV Y	$X = 0.10$ per unit
T2	1000 MVA	15 kV Δ/765 kV Y	$X = 0.10$ per unit
T3	500 MVA	15 kV Y/765 kV Y	$X = 0.12$ per unit
T4	750 MVA	15 kV Y/765 kV Y	$X = 0.11$ per unit

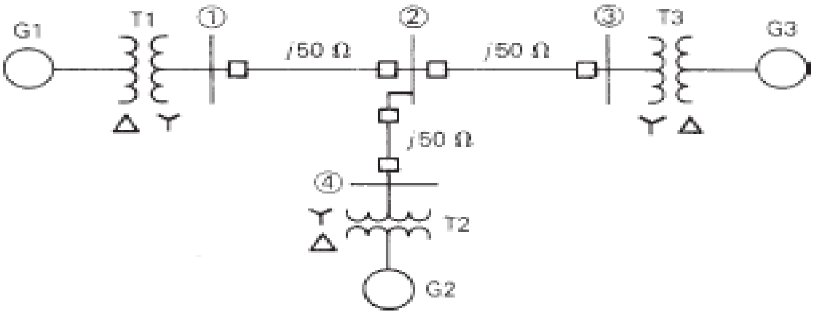


Transmission lines:

1–2	765 kV	$X_1 = 50\ \Omega,\ X_0 = 150\ \Omega$
1–3	765 kV	$X_1 = 40\ \Omega,\ X_0 = 100\ \Omega$
2–3	765 kV	$X_1 = 40\ \Omega,\ X_0 = 100\ \Omega$

The inductor connected to Generator 3 neutral has a reactance of 0.05 per unit using generator 3 ratings as a base. Draw the zero-, positive-, and negative-sequence reactance diagrams using a 1000-MVA, 765-kV base in the zone of line 1–2.

Q4/ Equipment ratings for the four-bus power system shown in Figure are given as follows:



Generator G1:	500 MVA, 13.8 kV, $X_d'' = X_2 = 0.20$, $X_0 = 0.10$ per unit
Generator G2:	750 MVA, 18 kV, $X_d'' = X_2 = 0.18$, $X_0 = 0.09$ per unit
Generator G3:	1000 MVA, 20 kV, $X_d'' = 0.17$, $X_2 = 0.20$, $X_0 = 0.09$ per unit
Transformer T1:	500 MVA, 13.8 kV Δ/500 kV Y, X = 0.12 per unit
Transformer T2:	750 MVA, 18 kV Δ/500 kV Y, X = 0.10 per unit
Transformer T3:	1000 MVA, 20 kV Δ/500 kV Y, X = 0.10 per unit
Each line:	$X_1 = 50$ ohms, $X_0 = 150$ ohms

The inductor connected to generator G3 neutral has a reactance of 0.028 pu. Draw the zero-, positive-, and negative-sequence reactance diagrams using a 1000-MVA, 20-kV base in the zone of generator G3

Q5/ A single-line diagram of a four-bus system is shown in Figure for which ZBUS is given below:

$$Z_{BUS} = j\begin{bmatrix} 0.25 & 0.2 & 0.16 & 0.14 \\ 0.2 & 0.23 & 0.15 & 0.151 \\ 0.16 & 0.15 & 0.196 & 0.1 \\ 0.14 & 0.151 & 0.1 & 0.195 \end{bmatrix} \text{ per unit}$$

Let a three-phase fault occur at bus 2 of the network.

(a) Calculate the initial symmetrical rms current in the fault.

(b) Determine the voltages during the fault at buses 1, 3, and 4.

(c) Compute the fault currents contributed to bus 2 by the adjacent un faulted buses 1, 3, and 4.

(d) Find the current flow in the line from bus 3 to bus 1. Assume the pre fault voltage Vf at bus 2 to be 1 ∟0 pu, and neglect all pre fault currents.