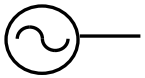
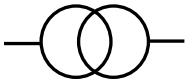
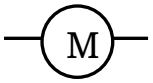
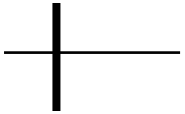
Lecture 1

CHAPTER 1 Per Unit Calculations

1. Power System Representation

Power Component		Symbol	Power Component		Symbol
	=	Generator		=	Circuit breaker
	=	Transformer		=	Transmission line
	=	Motor		=	Feeder + load
	=	Busbar (substation)			

Power components and symbols

Interconnections among these components in the power system may be shown is a so-called one-line diagram or single-line diagram. Single-line diagram represents all 3-ϕ of balanced system. For the purpose of analysis, the single-line diagram of a particular power system network is represented to its equivalent reactance or impedance diagram. A sample of a interconnected of individual power component is shown in Figure 1.1. This represent a circuit diagram of a power network which is referred to as a single-line diagram.

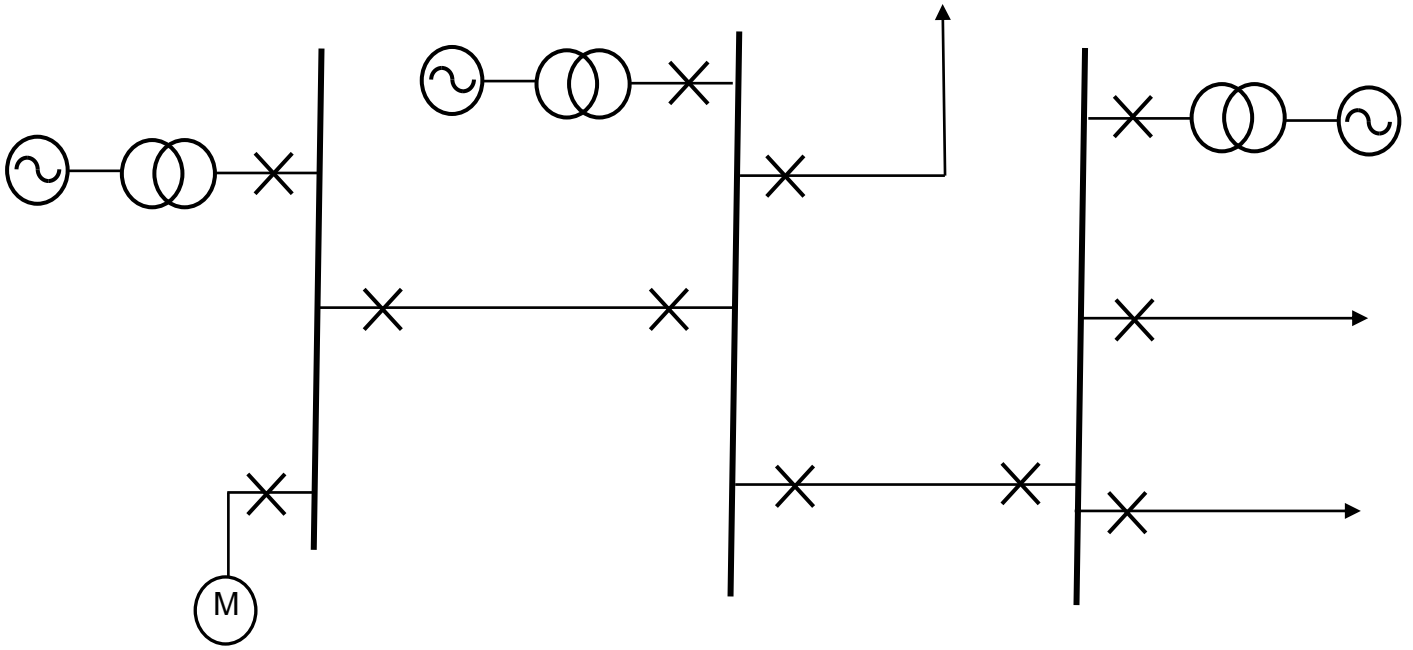


Figure 1.1 – Single-line diagram

Impedance diagram

In power system fault calculations it is often that a single-line diagram representing a typical power network in 3-ϕ be converted into its per phase impedance diagram. Some assumptions for converting from single-line diagram into its equivalent impedance diagram needed to be considered.

(i) A generator can be represented by a voltage source in series with an inductive reactance. The internal resistance of the generator is assumed to be negligible compared to the reactance.

(ii) The loads are usually inductive represented by resistance and inductance.

(iii) The transformer core is assumed to be ideal, and the transformer may be represented by a reactance only.

(iv) The transmission line is represented by its resistance and inductance, the line-to-ground capacitance is assumed to be negligible.

Let us consider the following on how the single-line diagram of Figure 1.2 converted into its impedance diagram counterpart.

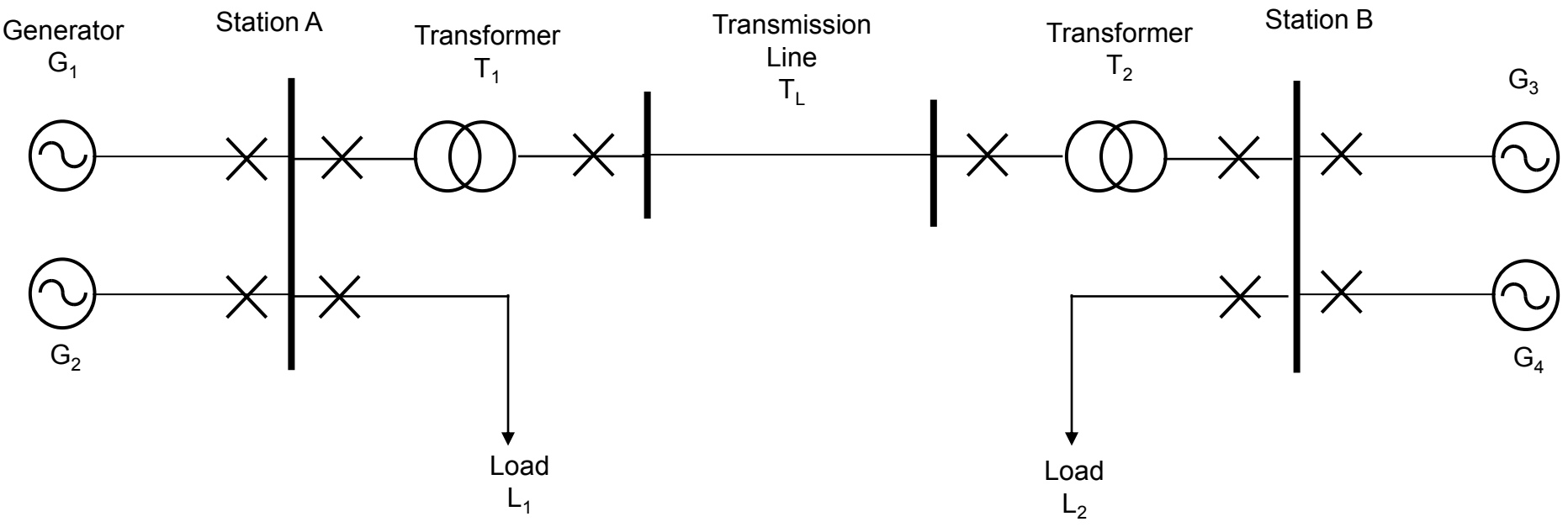


Figure 1.2 – Single-line diagram of a power network

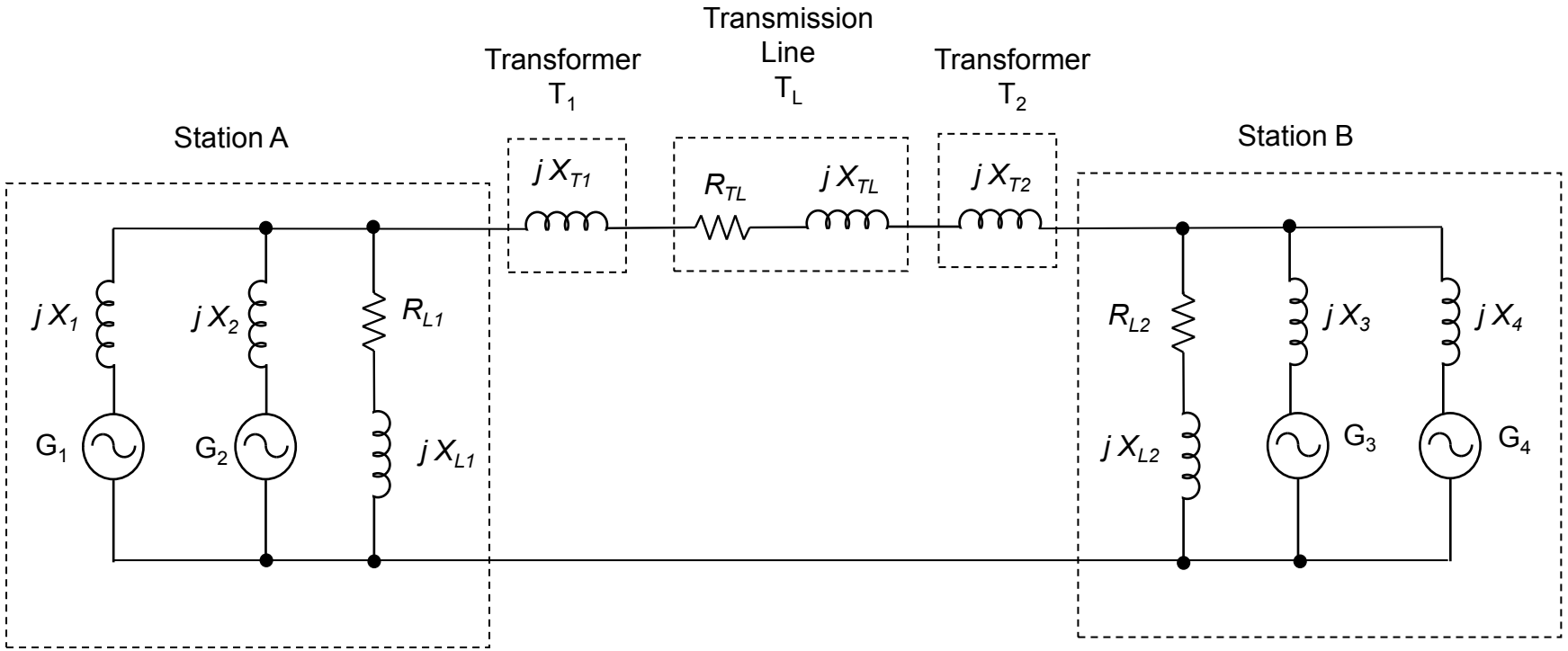


Figure 1.3 – Impedance diagram of Figure 1.2