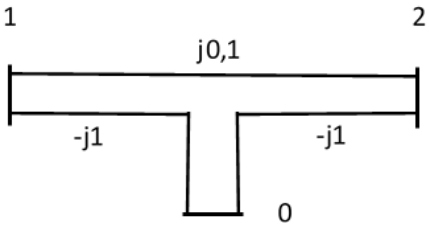
CALCULATION OF ELECTRICAL NETWORK MATRICES

Exercise 1

Consider the following network.



1) Find the admittance matrix Y.

2) Form the impedance matrix Z following the order 0-1, 1-2, and 0-2.

Exercise 2

Let Y be the admittance matrix of a 3-bus network.

$$Y = \begin{bmatrix} 35 & -10 & -20 \\ a & 25 & 0 \\ -20 & b & c \end{bmatrix}$$

1) Find a and b.

2) Given that bus 3 is not connected to the reference bus, find c.

Exercice 3

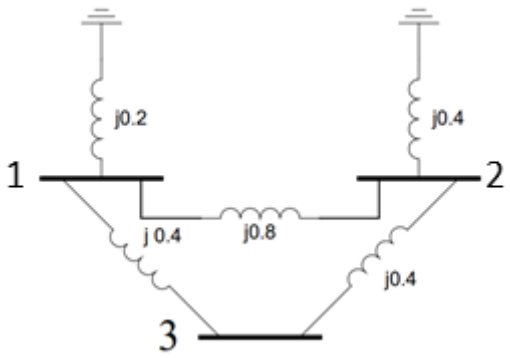
Let Y be the admittance matrix of a 3-bus network.

$$Y = \begin{bmatrix} a & -5 & -10 \\ -5 & 20 & -15 \\ -10 & -15 & 25 \end{bmatrix}$$

Bus 2 is to be eliminated, find the value of a if Y_{11} becomes equal to 33.25.

Exercise 4

Consider the 3-bus electrical network in the figure below.



1) Form the matrixY_{bus}
2) Construct the Z_{bus} matrix by following the order of the following elements: 1-0, 2-0, 1-3, 1-2 and 2-3.

Reminder: Z_{bus} construction formulas

Table 4.1 Summary of equations for formation of bus impedance matrix

Add p–q	Mutual coupling: p is not the reference bus	Mutual coupling: p is the reference bus	No mutual coupling: p is not the reference bus	No mutual coupling: p is the reference bus
Branch	$Z_{qi} = Z_{pi} + \dfrac{\tilde{y}_{pq,pq}(\bar{Z}_{pi} - \bar{Z}_{qi})}{y_{pq,pq}}$, $i = 1, 2, \ldots, m$, $i \neq q$	$Z_{qi} = \dfrac{\tilde{y}_{pq,pq}(\bar{Z}_{pi} - \bar{Z}_{qi})}{y_{pq,pq}}$, $i = 1, 2, \ldots, m$, $i \neq q$	$Z_{qi} = Z_{pi}$, $i = 1, 2, \ldots, m$, $i \neq q$	$Z_{qi} = 0$, $i = 1, 2, \ldots, m$, $i \neq q$
	$Z_{qq} = Z_{pq} + \dfrac{1 + \tilde{y}_{pq,pq}(\bar{Z}_{pq} - \bar{Z}_{qq})}{y_{pq,pq}}$	$Z_{qq} = \dfrac{1 + \tilde{y}_{pq,pq}(\bar{Z}_{pq} - \bar{Z}_{qq})}{y_{pq,pq}}$	$Z_{qq} = Z_{pq} + z_{pq,pq}$	$Z_{qq} = z_{pq,pq}$
Link	$Z_{li} = Z_{pi} - Z_{qi} + \dfrac{\tilde{y}_{pq,pq}(\bar{Z}_{pi} - \bar{Z}_{qi})}{y_{pq,pq}}$, $i = 1, 2, \ldots, m$, $i \neq l$	$Z_{li} = -Z_{qi} + \dfrac{\tilde{y}_{pq,pq}(\bar{Z}_{pi} - \bar{Z}_{qi})}{y_{pq,pq}}$, $i = 1, 2, \ldots, m$, $i \neq l$	$Z_{li} = Z_{pi} - Z_{qi}$, $i = 1, 2, \ldots, m$, $i \neq l$	$Z_{li} = -Z_{qi}$, $i = 1, 2, \ldots, m$, $i \neq l$
	$Z_{ll} = Z_{pl} - Z_{ql} + \dfrac{1 + \tilde{y}_{pq,pq}(\bar{Z}_{pl} - \bar{Z}_{ql})}{y_{pq,pq}}$	$Z_{ll} = -Z_{ql} + \dfrac{1 + \tilde{y}_{pq,pq}(\bar{Z}_{pl} - \bar{Z}_{ql})}{y_{pq,pq}}$	$Z_{ll} = Z_{pl} - Z_{ql} + z_{pq,pq}$	$Z_{ll} = -Z_{ql} + z_{pq,pq}$
	Modification of the elements for elimination of lth node			
	$Z_{ij\,(\text{modified})} = Z_{ij\,(\text{before elimination})} - \dfrac{Z_{il}Z_{lj}}{Z_{ll}}$, $i, j = 1, 2, \ldots, m$			