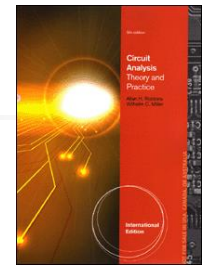


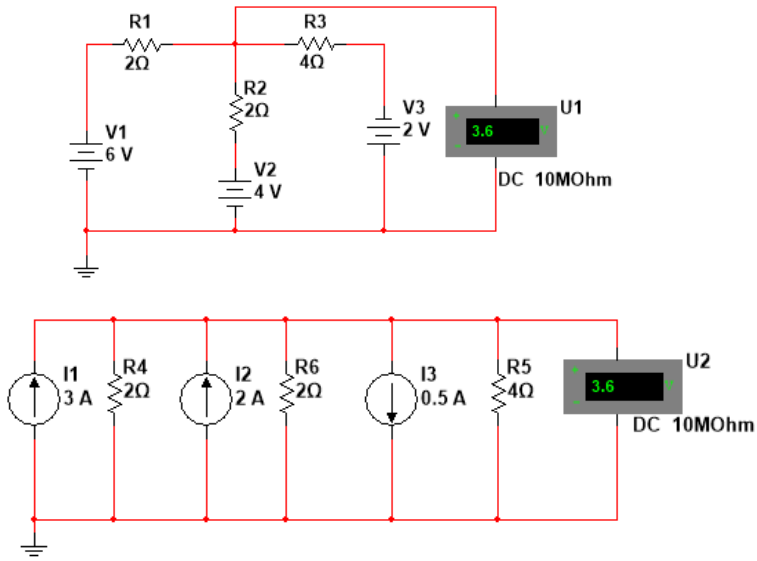
Chapter 08

Methods of Analysis
分析方法

Outline

- Source Conversion 電源轉換
- Mesh Analysis 迴路分析法
- Nodal Analysis 節點分析法
- Delta-Wye (Δ-Y) Conversion Δ-Y轉換
- Bridge Networks 電橋網路

Using Source Conversions
電源轉換



Branch Current Analysis
分支電流 分析法

Used for circuits having more than one source

Step0: Arbitrarily Assume all the current I_1, I_2, …
任意指定所有分支電流任一方向 I_1, I_2, …

Step1: Label polarities of the voltage drops across all resistors
依指定電流方向來標示每個電阻的電壓+、- 端

Step2: Write KVL around all loops
列出所有閉迴路之KVL式子

Step3: Apply KCL at enough nodes so all branches have been included
列出所有節點之KCL式子

Step4: Solve resulting equations 解聯立方程式

Mesh Analysis
迴路分析法

Step0: Arbitrarily assign a clockwise current to each interior closed loop (Mesh)

對每一個閉迴路任意指定電流方向 I_1, I_2, …

Step1: Indicate voltage polarities across all resistors

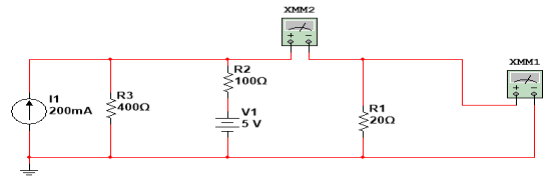
依指定電流方向來標示每個電阻的電壓+、- 端

Step2: Write KVL equations

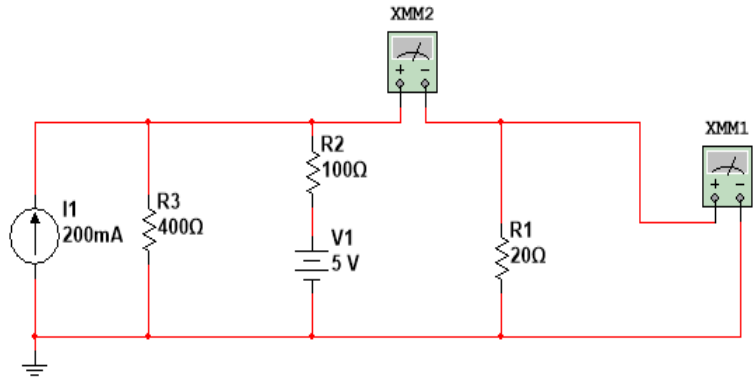
列出所有閉迴路之KVL式子

Step3: Solve resulting simultaneous equations

解聯立方程式，求電流 I_1, I_2, …



Mesh Analysis
迴路分析法



Nodal Analysis
節點分析法

Step0: Assign a reference node within circuit and indicate node **as ground** 區分一般節點與參考節點(接地)

Assign voltages V_1, V_2, ... to nodes

指定每個節點及標示電壓 V_1, V_2, ...

Step1: Arbitrarily assign a current direction to each branch at a node.

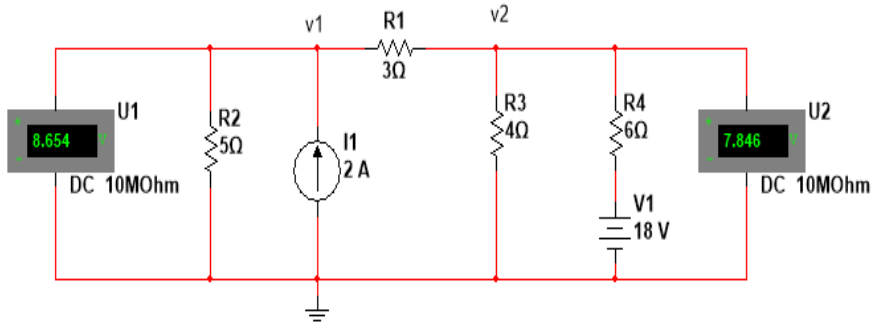
對每一節點定任意標示其分支電流方向

Step2: Apply KCL to all nodes except reference node **列出每一節點(接地點除外)之KCL式子**

Step3: Solve resulting equations for voltages

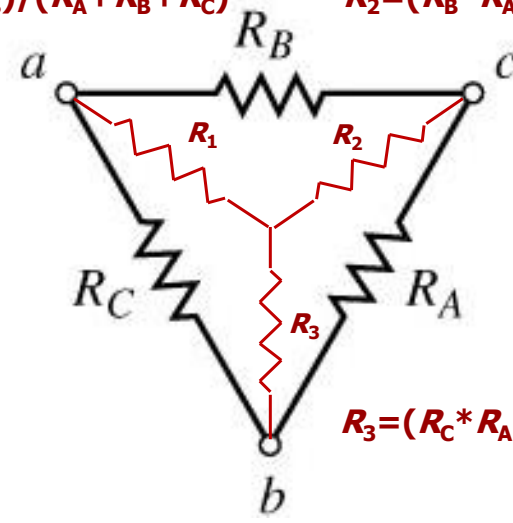
解聯立方程式，求電壓 V_1, V_2, ...

Nodal Analysis
節點分析法



Delta-Wye (Δ-Y) Conversion
Δ型連接 轉換為 Y型連接
對應左右電阻相乘 除以 所有電阻相加

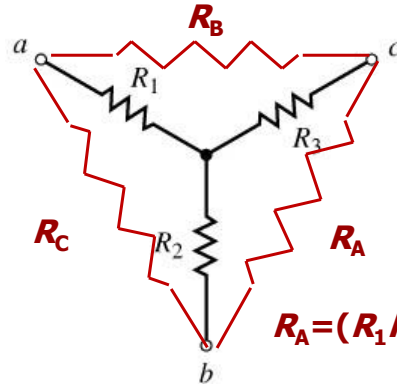
$R_1=(R_C*R_B)/(R_A+R_B+R_C)$ $R_2=(R_B*R_A)/(R_A+R_B+R_C)$



$R_3=(R_C*R_A)\ /\ (R_A+R_B+R_C)$

Delta-Wye (Δ-Y) Conversion
Δ型連接 轉換為 Y型連接
兩兩電阻相乘後加起來 除以 對應電阻

$R_B=(R_1R_2+R_2R_3+R_1R_3)/R_2$



$R_A=(R_1R_2+R_2R_3+R_1R_3)/R_1$

$R_C=(R_1R_2+R_2R_3+R_1R_3)/R_3$

Bridge Networks
電橋網路

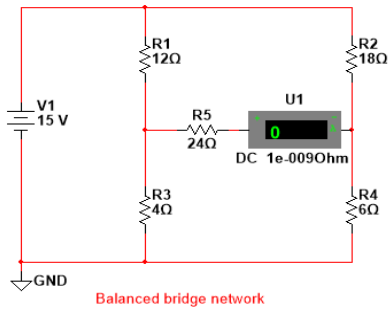
- **Balanced bridge**: 平衡電橋條件

  $R_1R_4 = R_2R_3$ and $I_{R5}=0$ and $V_{ab}=0$

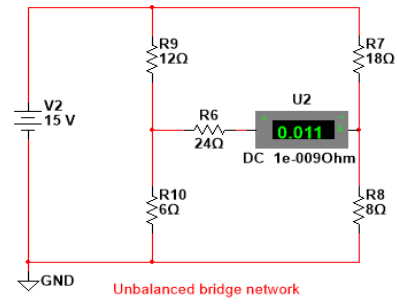
  R_5 可視為開路或短路

- **Unbalanced bridge:** 不平衡電橋條件

  $R_1R_4 \neq R_2R_3$ and $I_{R5}\neq 0$



Balanced bridge network



Unbalanced bridge network

Kernel abilities

1. Can use Voltage and Current conversion for analyze a circuit
2. Can use Mesh Analysis for solving the unknown voltage and current of a circuit.
3. Can use Nodal Analysis for solving the unknown voltage and current of a circuit.
4. Can use Delta-Wye (Δ-Y) Conversion for solving the unknown voltage and current of a circuit.
5. Can recognize a Bridge circuit whether is balanced or unbalanced and solve the unknown voltage and current.