5.10.2016

- 20p { Bonus / Test-papers (1-2)
- 40p Partial { 10 T / 15 A_1 / 15 A_2
- 40p - Final { 10 T / 15 A_1 / 15 A_2

§ 1. Direct Current Circuits

Methods of solving DC circuits
Theorems
Elements & topology
Kirchoff 1 & 2
Vaschy 1 & 2
Th → equivalences series, paralel, Δ - ★
Th of reconservation
superposition
reciprocity

Meth. of 1) eq. transf.
2) Kirchoff system of equations
3) Loop currents
4) Potential at nodes

§ 2. AC - circuits

Variable Sinusoidal
Variable Sources
Elements of the circuit R, L, C
Paralel / Series Structures
Complex Analysis of the AC circuits

Complex Power
Circuits with Coupled Coils (Self / mutual)
3 phase AC circuits

§ 3. Analysis of nonsinusoidal (periodic time-var) circuits

→ Decomposing on harmonics DC + AC power

§ 4. Transcent state
Direct Method
Laplace Method

Introduction

Topology
Elements of the circuits

Nodes N
Branches B
Loops L

- N represents the connection of minimum 3 branches
- B = the direct connection between 2 nodes
- L = a close path starting from one node & ending to the same node without crossing twice any branch

Elements < passive / active

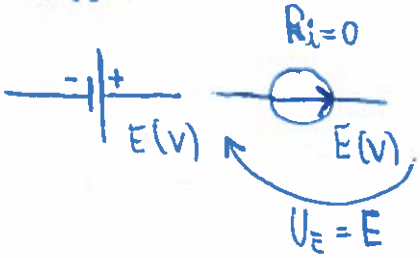
Passive (receptors)

resistor

$U_R = R \cdot i$
(V)

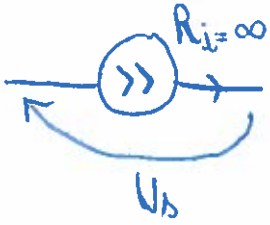
Active elements (generators)

• Voltage source



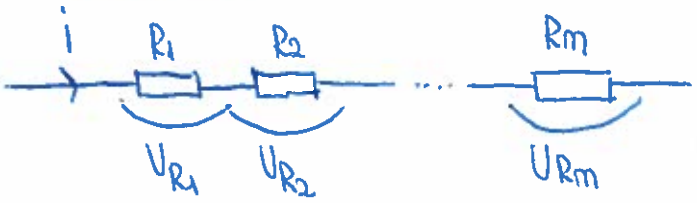
• Current source

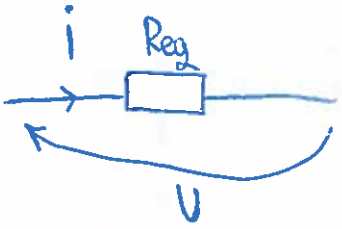
G = conductance (S) $\quad G = \frac{1}{R}$



Series & Parallel connection of passive elements

SERIES :





$$U = R_{eq} \cdot i$$

$$U = U_{R_1} + U_{R_2} + \dots + U_{Rm}$$

$$= R_1 \cdot i + R_2 \cdot i + \dots + Rm \cdot i$$

$$= i \cdot (R_1 + R_2 + \dots + Rm)$$

$$R_{eq} = \sum_{k=1}^{n} R_k$$

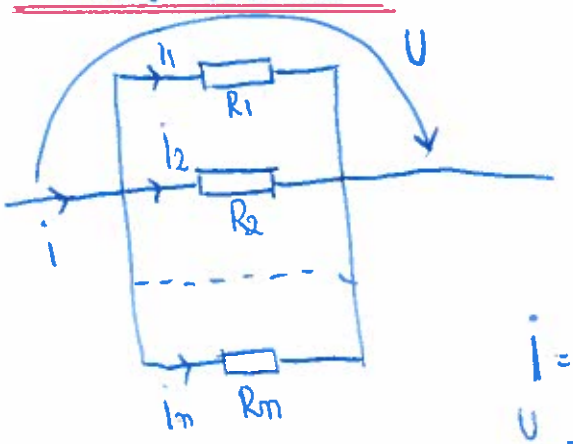
Voltage divider (4)

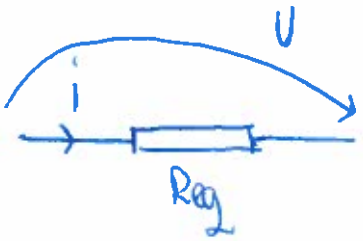
$$U_{R_1} = R_1 \cdot \underbrace{i}_{\frac{U}{R_{eq}}} = \frac{R_1}{R_{eq}} \cdot U = \frac{R_1}{\sum_1^n R_k} \cdot U$$

$$U_{R_k} = \frac{R_k}{\sum_{k=1}^{n} R_k} \cdot U$$

formula

Parallel connection





$$\dot{I} = \dot{I}_1 + \dot{I}_2 + \dots + \dot{I}_n$$

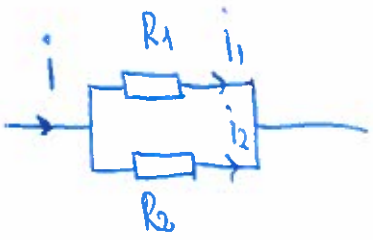
$$\frac{U}{R_{eq}} = \frac{U}{R_1} + \frac{U}{R_2} + \dots + \frac{U}{R_n}$$

$$R_{eq_p} = \frac{1}{\sum_{k=1}^{n} \frac{1}{R_k}}$$

Current divider

$$\dot{I}_1 = \frac{U}{R_1} = \frac{\dot{I} \cdot R_{eq}}{R_1} = \frac{\dot{I}}{R_1} \cdot \frac{1}{\sum \frac{1}{R_K}} \Rightarrow$$

$$\dot{I}_k = \dot{I} \cdot \frac{1}{R_k \cdot \sum_{K=1}^{n} \frac{1}{R_K}}$$ formula



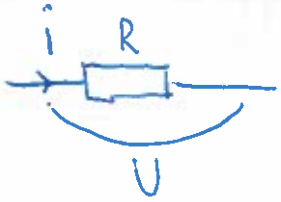
$$U = R_1 \cdot I_1$$

$$U = R_2 \cdot I_2 = \dot{I} \cdot \frac{R_1 R_2}{R_1 + R_2}$$

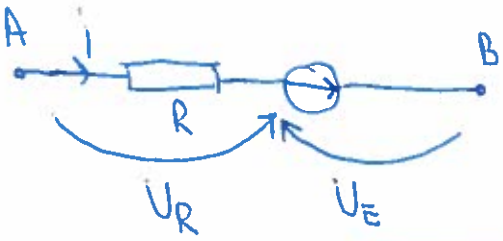
$$\dot{I}_2 = \frac{\dot{I} R_1 R_2}{R_2 (R_1 + R_2)} = \frac{\dot{I} R_1}{R_1 + R_2}$$

$$\dot{I}_1 = \frac{\dot{I} R_1 R_2}{R_1 (R_1 + R_2)} = \frac{\dot{I} R_2}{R_1 + R_2}$$

Ohm's Law



$U = R \cdot i \mid R$



$U = U_R - U_E = R \cdot i - E \mid :R$

$U_{BA} = U_E - U_R = E - R \cdot i$

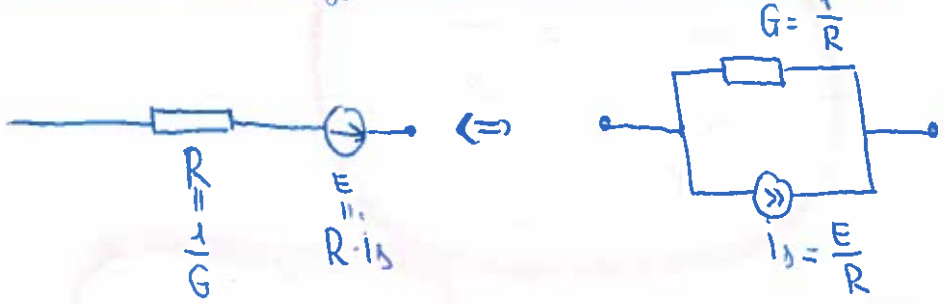
$\frac{U}{R} = i \Rightarrow$ **$i = G \cdot U$** ★

$U \cdot \frac{1}{R} = i - \frac{E}{R}$

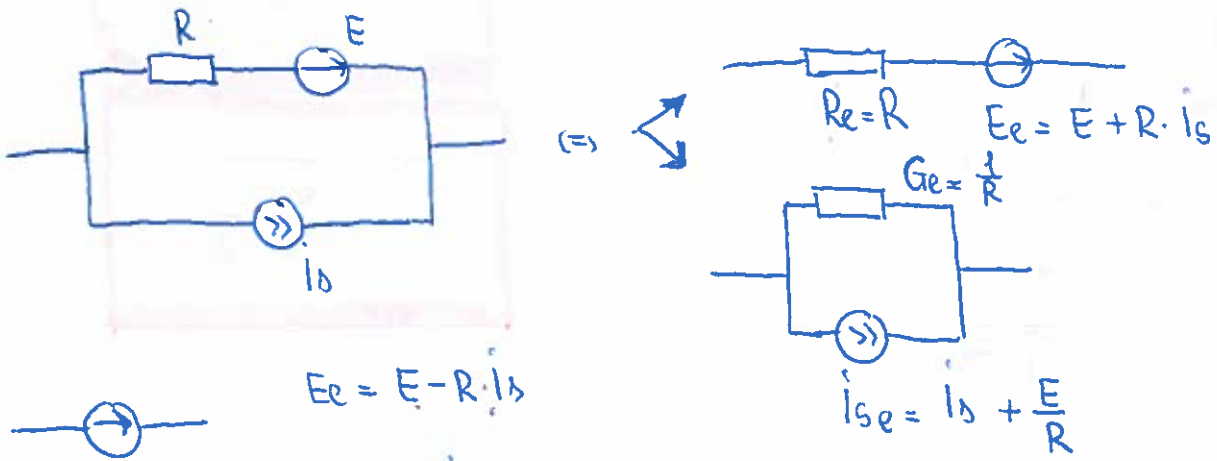
★ **$GU = I - GE$**

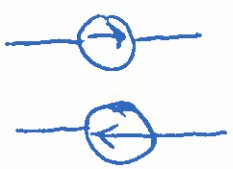
Theorems of equivalent transformation

1)



2)



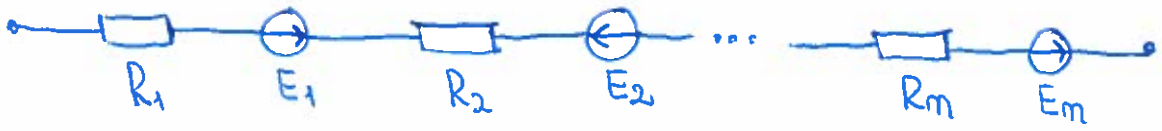


$E_e = E - R \cdot i_S$

$E_e = R \cdot i_S - E$

3).

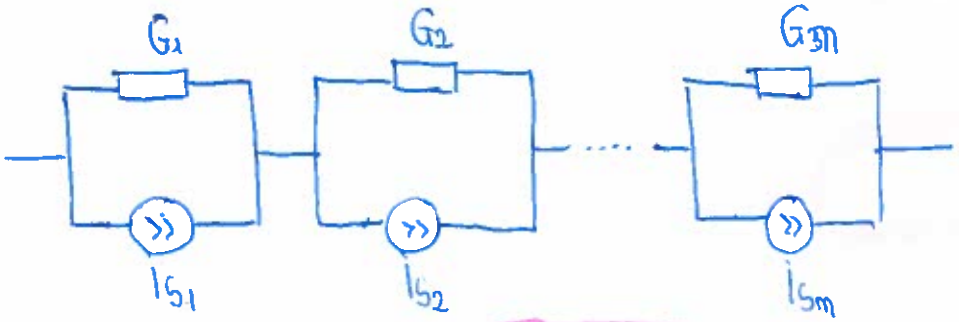
a).

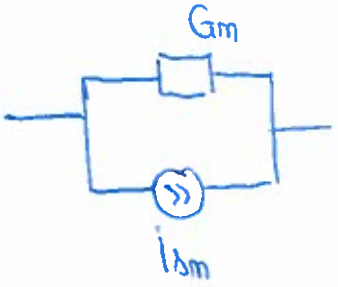


$$R_e = \sum_{k=1}^{m} R_k$$

$$E = \sum_{k=1}^{m} E_k$$

b).

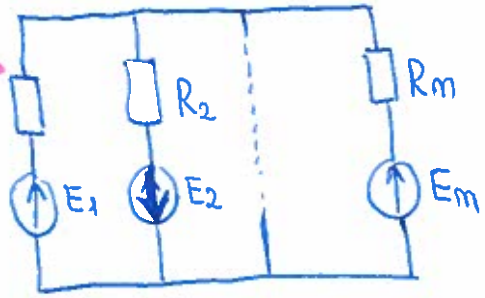




$$i_{SK} = \frac{\sum R_K \cdot i_{SK}}{\sum R_K}$$

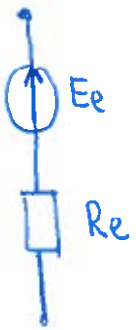
$$G_K = \frac{1}{\sum \frac{1}{G_K}}$$

4) a).

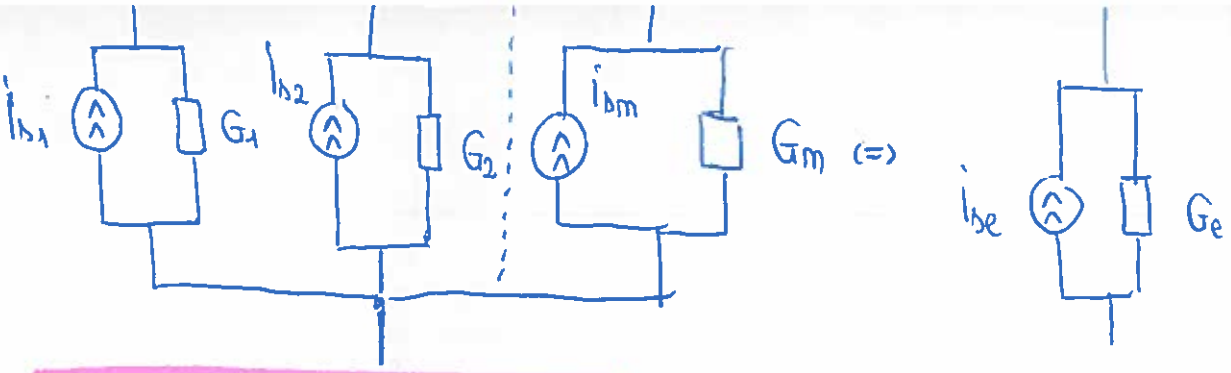


$$E_e = \frac{\sum E_K G_K}{\sum G_K}$$

$$R_e = \frac{1}{\sum_{k=1}^{m} \frac{1}{R_k}}$$

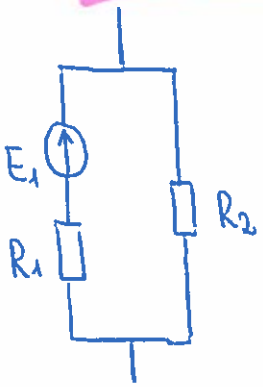


4 b).



$$G_e = \sum G_k$$

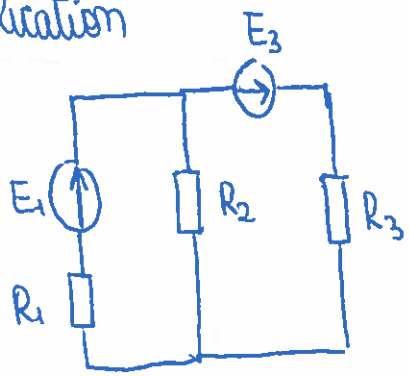
$$i_{se} = \sum_{k=1}^{n} i_{sk} \quad alg$$



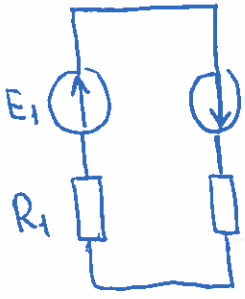
$$R_e = \frac{R_1 R_2}{R_1 + R_2}$$

$$E_e = \frac{\frac{E_1}{R_1} + 0}{\frac{1}{R_1} + \frac{1}{R_2}} = \frac{E_1 R_2}{R_1 + R_2}$$

aplication

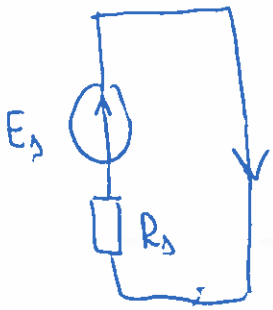


R(Ω)	I(A)	E(V)
$R_1 = 3$		$E_1 = 34$
$R_2 = 6$		
$R_3 = 6$		$E_3 = 16$



$$E_{23} = \frac{E_3 \cdot R_2}{R_2 + R_3} = \frac{16 \cdot 6}{12} = 8V$$

$$R_{23} = \frac{R_2 R_3}{R_2 + R_3} = \frac{36}{12} = 3\Omega$$



$$E_1 = E_1 + E_{23} = 34 + 8 = 42V$$

$$R_1 = R_1 + R_{23} = 6\Omega$$

$$I_1 = \frac{E_1}{R_1} = \frac{42}{6} = 7$$