University of Kasdi Merbah Ouargla
Faculty of New Technologies for the Information and Communication
Department of Electronics and Communications

Module: *Fundamental Electrical Engineering 1*

L2 ST ***Dr**: M. Bouzidi / **Dr**: M. Korichi*

Exam (1h :30 min)

اللقب: .....

الاسم: .....

الشعبة: ..... الفوج: .....

_____
20

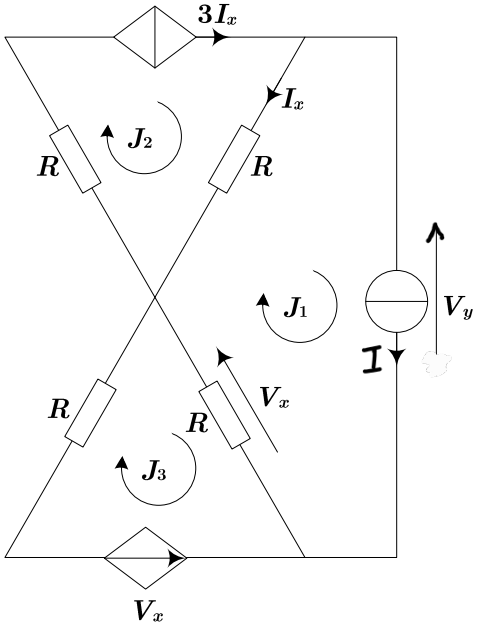
*

Exercise 1 (6 pts)

Using the mesh analysis, find J_1, J_2 and J_3.

Deduce the voltage V_y.

$I = 12$ A, $R = 10\ \Omega$.



Solution

Mesh (1): *0.75 pt*

$J_1 = I$

Mesh (2): $J_2 = 3I_x$ *0.75 pt*

Mesh (3): $V_x + RJ_3 + R(J_3 - J_1) = 0$ *0.75 pt*

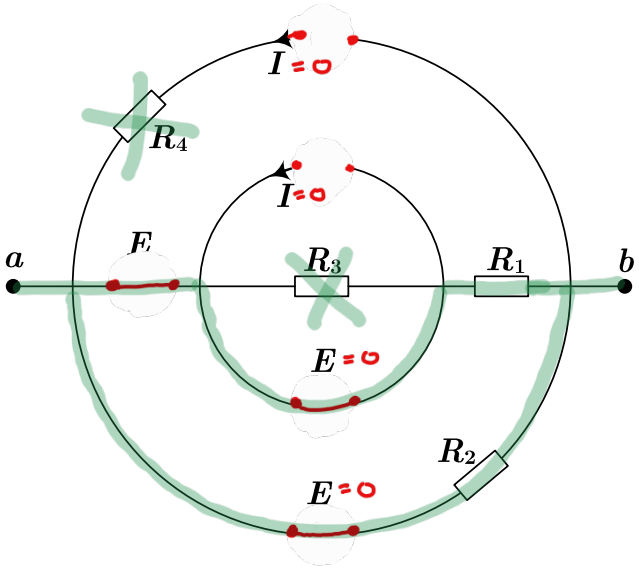
$I_x = J_2 - J_1$ *0.5 pt* $V_x = R(J_3 - J_1)$ *0.5 pt* $V_y = R(J_2 - J_1) + R(J_3 - J_2)$ *0.75 pt*

$J_1 = 12$ A *0.5 pt*	$J_2 = 18$ A *0.5 pt*	$J_3 = 8$ A *0.5 pt*	$V_y = 20$ V *0.5 pt*

Exercise 2 (2 pts)

Find the Thevenin's resistor between ***a*** and ***b***.

R_1=10Ω, R_2=15, R_3=20Ω, R_4=15Ω.



Solution

R_{Th}= $R_1 // R_2 = \frac{R_1 \cdot R_2}{R_1 + R_2}$ ..... 1 pt

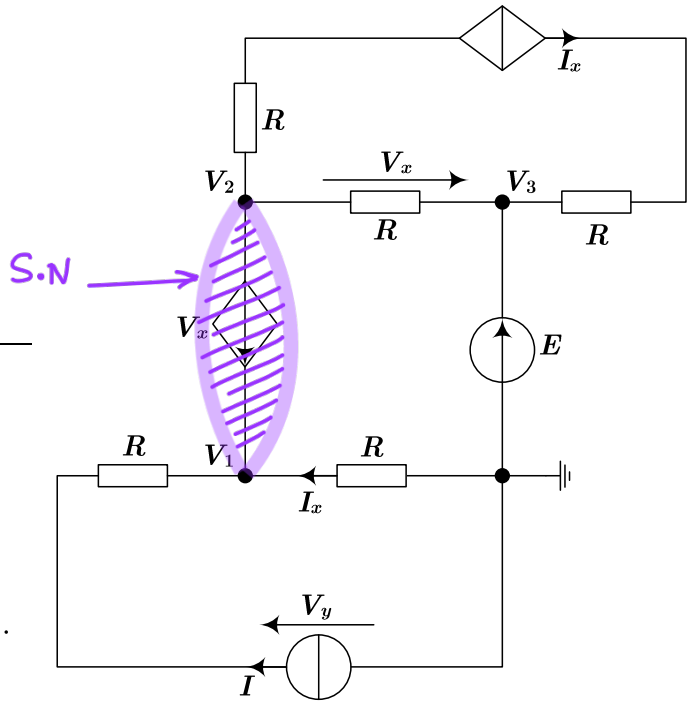
R_{Th}= ..... 6 ..... Ω 1 pt

Exercise 3 (6 pts)

Using the nodal analysis, find V_1, V_2 and V_3.

Deduce the voltage V_y.

E =120V, I=10A, R=10Ω.



Solution

Node (1,2): 0.75 pt

(S.N): $\frac{V_1}{R} + \frac{V_2 - V_3}{R} = I - I_x$

Node (1,2): $V_1 - V_2 = V_x$ 0.75 pt

Node (3): $V_3 = E$ 0.75 pt

I_x = $-\frac{V_1}{R}$ 0.5 pt

V_x = $V_3 - V_2$ 0.5 pt

V_y = $V_1 + R\,I$ 0.75 pt

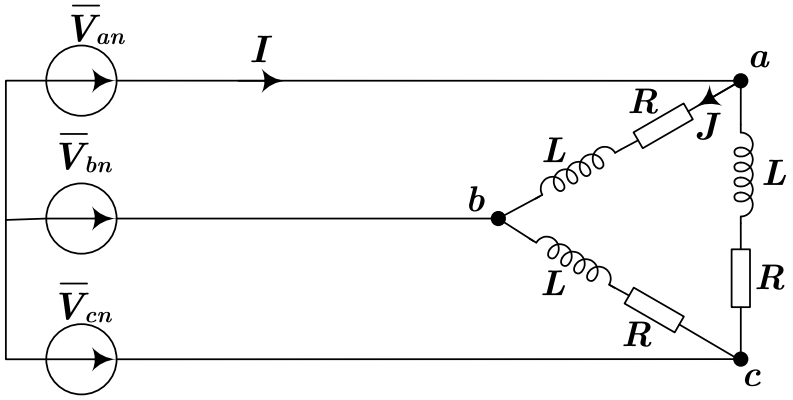
0.5 pt 0.5 pt 0.5 pt 0.5 pt

V_1= 120 V V_2= 220 V V_3= 120 V V_y= 220 V

Exercise 3 (6 pts)

The three-phase balanced system 220/380V 50Hz in the figure below supplies a three inductive impedances $\bar{Z} = 50\angle 45^{\circ}\Omega$ contains R=?, L=100 mH.

1- What is the type of connection?
2- What the voltage across each impedance.
3- Calculate the value of the resistance R.
4- Calculate the phase current $\boldsymbol{J}$, the line current $\boldsymbol{I}$, and the power factor.
5- Calculate the active power $\boldsymbol{P}$, reactive $\mathbf{Q}$, and apparent power $\boldsymbol{S}$.
6- Calculate the capacitor coupled in delta that raises the power factor to $\boldsymbol{1}$.
7- In the phasor diagram showing below, represent the vectors : $\boldsymbol{U_{ab}}$, $\boldsymbol{U_{bc}}$, $\boldsymbol{U_{ca}}$, $\boldsymbol{J_{ab}}$, $\boldsymbol{J_{bc}}$, $\boldsymbol{J_{ca}}$.



Solution

1- The type of connection is : Delta ..... *0.25 pt*

2- The voltage across each impedance is 380 ..... V *0.25 pt*

3- Calculation of resistance $\boldsymbol{R}$:

$R = \sqrt{Z^2 - (L\omega)^2}$, $R = 38.9\ \Omega$,

0.25 pt *0.25 pt*

$\frac{380}{50}$

4- Calculation of the phase current $\boldsymbol{J}$, line current $\boldsymbol{I}$, and the power factor $\boldsymbol{PF}$.

$J = \frac{U}{Z}$, $J = 7.6\ A$, *0.25 pt* *0.25 pt*

$I = \sqrt{3}J$, $I = 13.16\ A$, *0.25 pt* *0.25 pt*

$PF = \cos(45^{\circ})$, $PF = 0.7$ *0.25 pt* *0.25 pt*

5- Powers calculation

- P = $\sqrt{3}\,U \cdot I \cdot \cos\varphi$, P = 6,12 kW (0.25 pt) (0.25 pt)
- Q = $\sqrt{3}\,U \cdot I \sin\varphi$, Q = 6,12 kVar (0.25 pt) (0.25 pt)
- S = $\sqrt{3}\,U \cdot I = \sqrt{P^2 + Q^2}$, S = 7,24 kVA (0.25 pt) (0.25 pt)

6- Capacitor calculation

- C = $\dfrac{P(\operatorname{tg}(45^\circ) - \operatorname{tg}(0^\circ))}{3U^2 \cdot \omega}$, C = $4{,}50 \times 10^{-5}$ F (0.25 pt) (0.25 pt)

7- Phasor diagram, Representation of the vectors: U_{ab}, U_{bc}, U_{ca}, J_{ab}, J_{bc}, J_{ca}