INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Název projektu**: Automatizace výrobních procesů ve strojírenství a řemeslech**
Registrační číslo: **CZ.1.07/1.1.30/01.0038**
Příjemce: **SPŠ strojnická a SOŠ profesora Švejcara Plzeň, Klatovská 109**
Tento projekt je spolufinancován Evropskou unií a státním rozpočtem České republiky

Produkt:

Zavádění cizojazyčné terminologie do výuky odborných předmětů a do laboratorních cvičení

AC circuits: displaying a basic quantities

Návod v anglickém jazyce

Číslo tématu: **12b**

Monitorovací indikátor: **06.43.10**

INSTRUCTIONS FOR TOPIC: 12b

Created in school year: 2012/2013

Branch: 23-41-M/01 Mechanical Engineering

Subject: Electrical Engineering

Year: 3.

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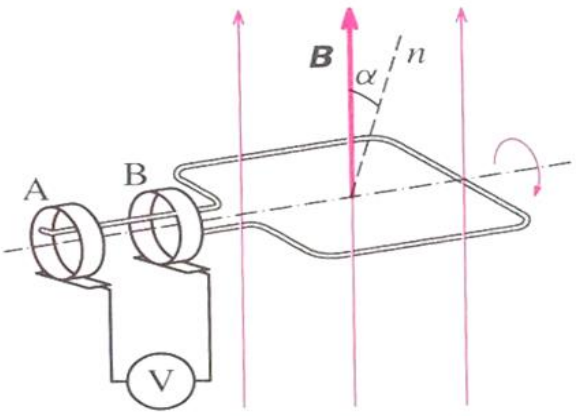
AC circuits: displaying a basic quantities

Alternating current model

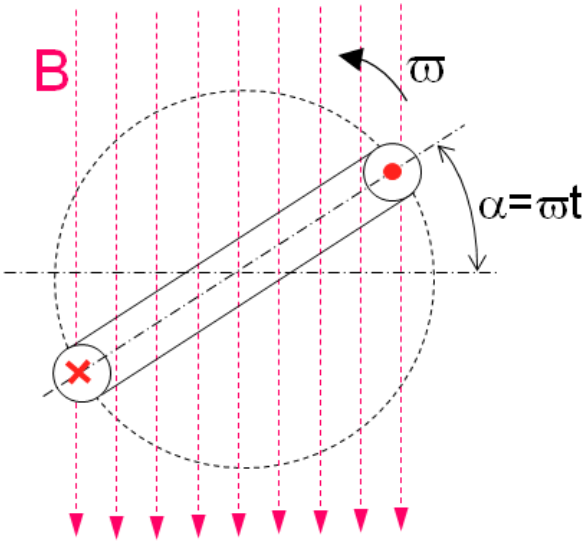
If a thread rotates in a magnetic field, at every moment voltage u induces in it.



Picture description:

A,B – rings designated for collecting of the voltage (measured by voltmeter V). Arrow B – mark the direction of induction, which means a time-invariant magnetic field. It is formed by a permanent magnet or by a coil powered by direct current.

Schematic illustration of conductor motion



Instantaneous value of voltage

$$u_i = 2 \cdot B \cdot l \cdot v \cdot \sin\alpha$$

$$\sin\alpha = 1 \rightarrow U_{max} = 2 \cdot B \cdot l \cdot v$$

$$u_i = U_{max} \cdot \sin\alpha$$

B – magnetic field induction

l (2xl)– effective lenght of a thread

v – rotation speed- constant.

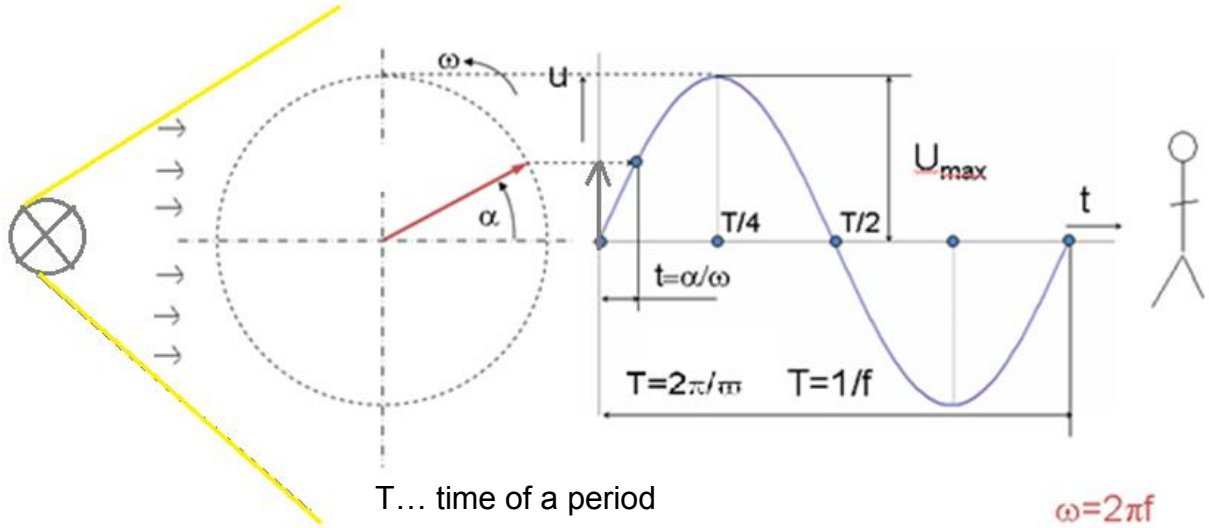
α - angle of instantaneous position of a thread and a vector of magnetic induction B. For rotary motion apply

$\alpha=\omega t$

Function sinα has values <-1,1> an maximum for sin is (α) = 1

The sign means the direction of the voltage, it means an interval <0,1>

Phasor depiction of alternative quantities



T… time of a period

f … frequency (number of periods in a second)

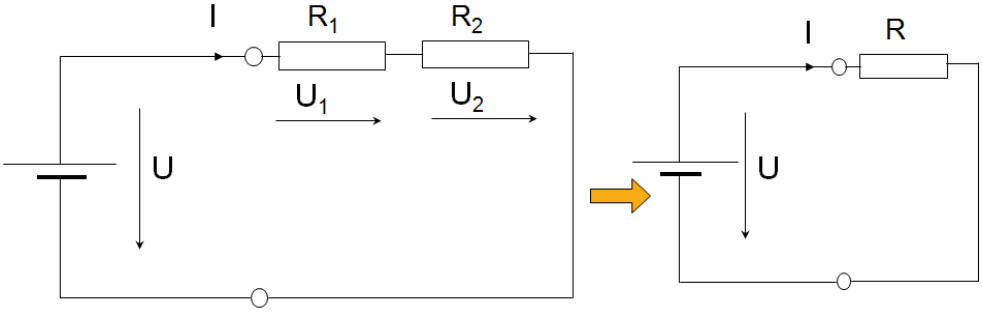
$\omega = 2\pi f$

Description: Axis u (y) is a projection screen which is seen by an observer(on the right). The arrows on the leftt stand for the light. The phasor is rotating. The observer can see a line segment changing in an interval <-Um;+Um> (lenght 0 appears as a point). Duration of the changes is equivalent to function sinus.

Phasor definition and phasor usage

Phasor is a vector of alternating voltage (current), it has both intensity and direction (polarity). It precisely fits the model. Phasors are displayed in complex plane where also alternative circuits are solved. Phasors are therefore added in vector way.

Examle: Resistors in series:



At direct circuits we add the voltage in scalar way.

SS circuits: resistance: $R = R_1 + R_2$

voltage: $U = U_1 + U_2$

current is the same in both resistors

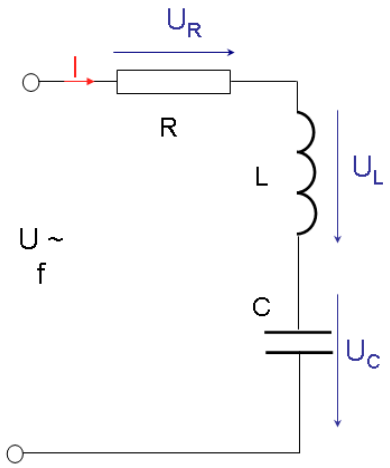
At alternative circuits the voltage has intensity and alternative direction – it is necessary to add it in vector way - phasor way.

~ circuits: resistance: $R = R_1 + R_2$

voltage: $\vec{U} = \vec{U}_1 + \vec{U}_2$

current is the same in both resistors

Example: series RLC circuit



Defined: UR, UL,UC

Calculate the total voltage

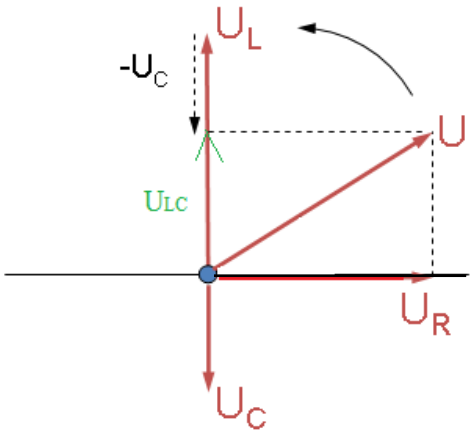
Solution:

The voltage is defined by a phasor in time t=0

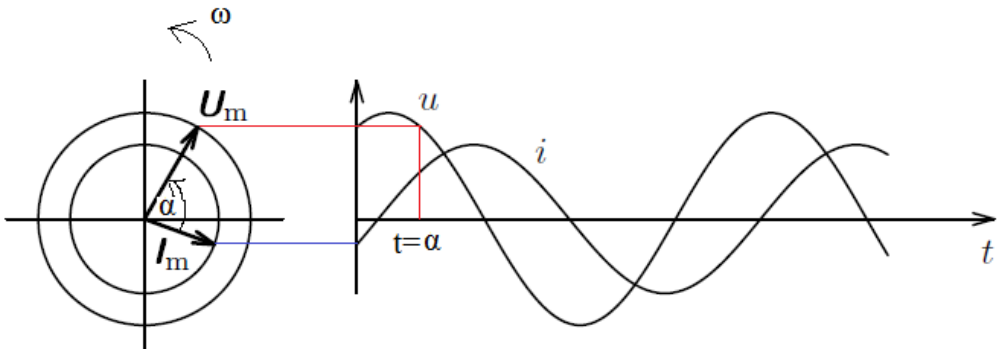
We add the phasors:

$U_{LC} = U_L - U_C$ (they are opposites, therefore „-“)

$\vec{U} = \vec{U}_{LC} + \vec{U}_R$



Example: of a reconstruction of 2 courses from phasors using a model



We rotate the phasor system in a direction of the arrow. On the axis y we can see the line equivalent to the course. The angle on the phasor diagram represents time shift between the courses.

Basic quantities used in description of alternative courses

Instantaneous values u, i are projections of phasors in a model

$$u = 2Blv\sin(\alpha) = U_{\max}\sin(\alpha) \qquad i = \frac{u}{R} = \frac{2Blv}{R}\sin(\alpha) = I_{\max}\sin(\alpha)$$

Maximum values U_{max}, I_{max} – maximum lenght of phasors

$$U_{\max} = 2Blv \qquad I_{\max} = \frac{2Blv}{R}$$

Effective values U_{ef}, I_{ef} – value equivalent to the direct current, which can perform equivalent mechanical work (output) in a resistor. Index „f“ is usually left out.

$$U_{ef} = \frac{1}{\sqrt{2}} \bullet U_{\max} = 0{,}707 \bullet U_{\max} = 1{,}414Blv \qquad I_{ef} = \frac{1}{\sqrt{2}} I_{ef} = 0{,}707\frac{U_{ef}}{R} = \frac{1{,}414Blv}{R}$$

Mean values $U_{stř}$, $I_{stř}$ – average value of the course (for calculation the absolute value is used) in 1 period. It is significant in electrolysis.

$$I_{stř} = \frac{2}{\pi} I_{\max} = 0{,}637\frac{U_{\max}}{R} = \frac{1{,}27Blv}{R} \qquad U_{stř} = \frac{2}{\pi} U_{\max} = 1{,}27Blv$$

Zdroje:

BLAHOVEC, A., *Elektrotechnika I,* Praha: Informatorium s.r.o., 2002. ISBN 978-80-7333-043-1.

BLAHOVEC, A., *Elektrotechnika II,* Praha: Informatorium s.r.o., 2002. ISBN 978-80-7333-044-6.

BLAHOVEC, A., *Elektrotechnika II,* Praha: Informatorium s.r.o., 2002. ISBN 978-80-7333-045-3.

Obvody střídavého proudu: zobrazování a základní veličiny - AC circuits: displaying a basic quantities - slovníček odborných termínů

Vocabulary	Slovníček
alternating current	střídavý proud
angle	úhel
circuit	obvod
coil	cívka
conductor	vodič
direct current	stejnosměrný proud
effective values	efektivní hodnoty
electrolysis	elektrolýza
induction	indukce
instantaneous values	okamžité hodnoty
magnetic field	magnetické pole
mean values	střední hodnoty
phasor	fázor
rotary motion	otáčivý pohyb
voltage	napětí
thread	závit