"بسم الله الرحمن الرحيم"

«تيار متردد» 2025 / 4 / 27

(AC) "دوائر التيار المتردد" ALTERNATING CURRENT «CIRCUITS (AC)»

دوائر التيار المتردد "AC CIRCUITS"

* • An AC Circuit Consists of a Combination of Circuit elements and a Power Source...

• تتكون دائرة التيار المتردد من مجموعة من عناصر الدائرة ومصدر طاقة.

• The Power Source provide an alternating Voltage, ΔV

• Notation note: $(v(t))$ *) يوفر مصدر الطاقة جهداً متردداً

• lower case symbols will indicate instantaneous values

• Capital letters will indicate fixed Values.

* The output of an (AC) power source is sinusoidal and varies with time according to the following equation:

• يكون خرج مصدر طاقة التيار المتردد جيبيًا ويتغير مع الوقت...

$$\boxed{\underbrace{\Delta V}_{\text{"الجهد اللحظي"}} = \underbrace{\Delta V_{max}}_{\text{سعة الجهد}} \sin \omega t}$$

• ΔV is The instantaneous Voltage

• ΔV_{max} is The maximum output Voltage of The Source "أقصى جهد"

• Also Called The Voltage amplitude "سعة الجهد"

• ω is The angular frequency of The (AC) Voltage.

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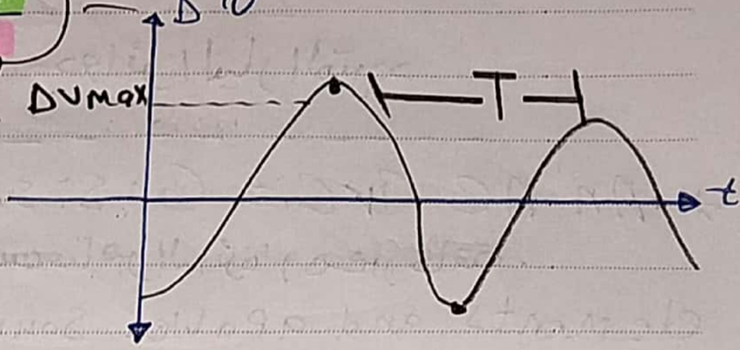
• The angular frequency is: $f = \frac{1}{s} = Hz$

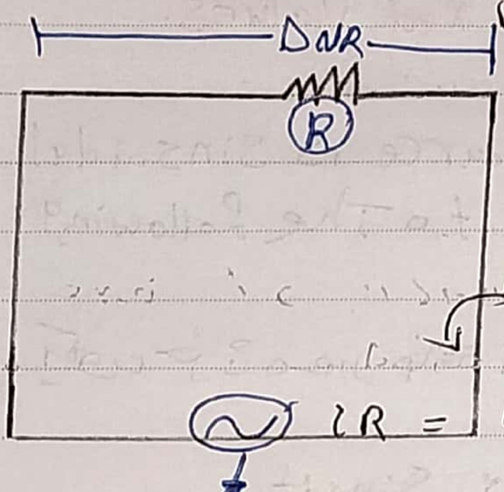
وحدة قياس التردد

$$\boxed{\omega = 2\pi f = \frac{2\pi}{T}}$$



"RESITORS IN AN AC CIRCUIT"

Apply Kirchhoff's loop rule There fore



قانون كيرشوف

$$\Delta V + \Delta V_R = Zero$$

"قانون كيرشوف عبارة عن مجموع الجهود في الدائرة المغلقة = صفر"

$$\Delta V - i_R R = Zero$$

$$\Delta V_{max}\sin(\omega t) - i_R R = Zero$$

$$i_R = \frac{\Delta V_{max}\sin\omega t}{R} = I_{max}\sin(\omega t)$$

$\Delta V = \Delta V_{max} \cdot \sin\omega t$ where: $I_{max} = \frac{\Delta V_{max}}{R}$

$$\boxed{\Delta V_R = I_{max}\sin\omega t \cdot R}$$

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"RMS CURRENT AND VoltAGE"

The average Current in one cycle is zero

- Resistors experience a temperature increase which depends on the magnitude of the current, but not the direction of the Current

$$\boxed{I_{rms} = \frac{I_{max}}{\sqrt{2}} = 0.707\, I_{max}}$$

- Alternating Voltages Can also be discussed in terms of rms values

$$\boxed{\Delta V_{rms} = \frac{\Delta V_{max}}{\sqrt{2}} = 0.702\, \Delta V_{max}}$$

"power"

- The rate at which electrical energy is delivered To a resistor in the circuit is given by

$$P = I^2 R$$

- The average power delivered to a resistor That carries an alternating Current is

$$P_{av} = I_{rms}^2 R$$

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Kirchhoff's loop rule can be applied and gives

$$\Delta V + \Delta V_L = 0 \quad \text{or}$$

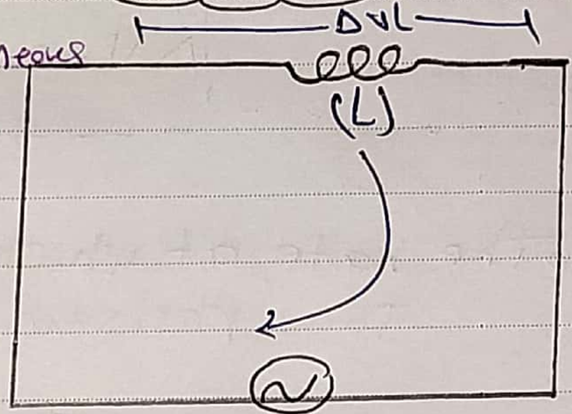
$$\Delta V - L\frac{di}{dt} = \text{Zero}$$

$$\Delta V = L\frac{di}{dt} = \Delta V_{max}\sin\omega t$$

$i_L = \frac{\Delta V_{max}}{L}\int \sin\omega t\, dt = -\frac{\Delta V_{max}}{\omega L}\cos\omega t$

$$i_L = \frac{\Delta V_{max}}{\omega L}\sin\left[\omega t - \frac{\pi}{2}\right] \quad \therefore \quad I_{max} = \frac{\Delta V_{max}}{\omega L}$$

This shows That The instantaneous



Current i_Ls in The inductor
and The instaneous voltage
ΔV_Ls across The
inducter are
out of by $(\pi/2)$ rad = 90°

$$\Delta V = \Delta V_{max}\sin\omega t$$

The instaneous voltage across The inductor is

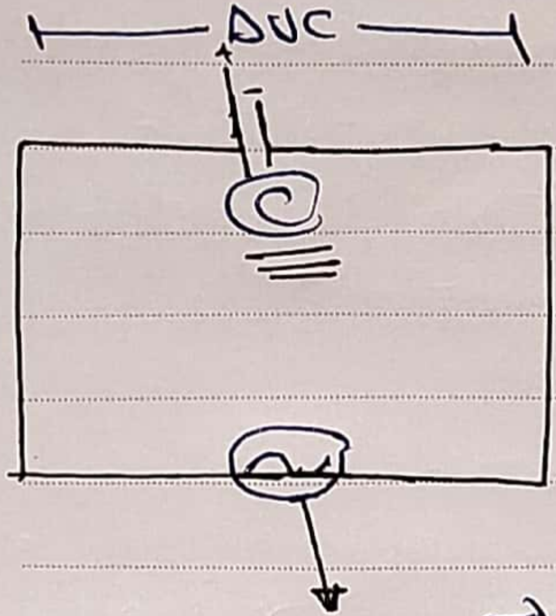
$$\Delta V_L = -L\frac{di}{dt}$$

$$= -\Delta V_{max}\cdot\sin\omega t$$

$$= -I_{max}\cdot X_L\sin\omega t$$

"الحمد لله"　　2025/4/27

The circuit Contains a Capacitor and an AC source.



$\Delta V + \Delta V_C = \text{Zero}$ and so

$$i_C = \frac{dq}{dt} = \omega C \Delta V_{max} \cos \omega t$$

or $i_C = \omega C \Delta V_{max} \sin(\omega t + \frac{\pi}{2})$

$$i_C = \nu C \Delta V_{max} \sin(\omega t + \frac{\pi}{2})$$

The Current is $\pi/2$ rad $= 90^\circ$ out Phase ($\Delta V = \Delta V_{max} \sin \omega t$) with The voltage