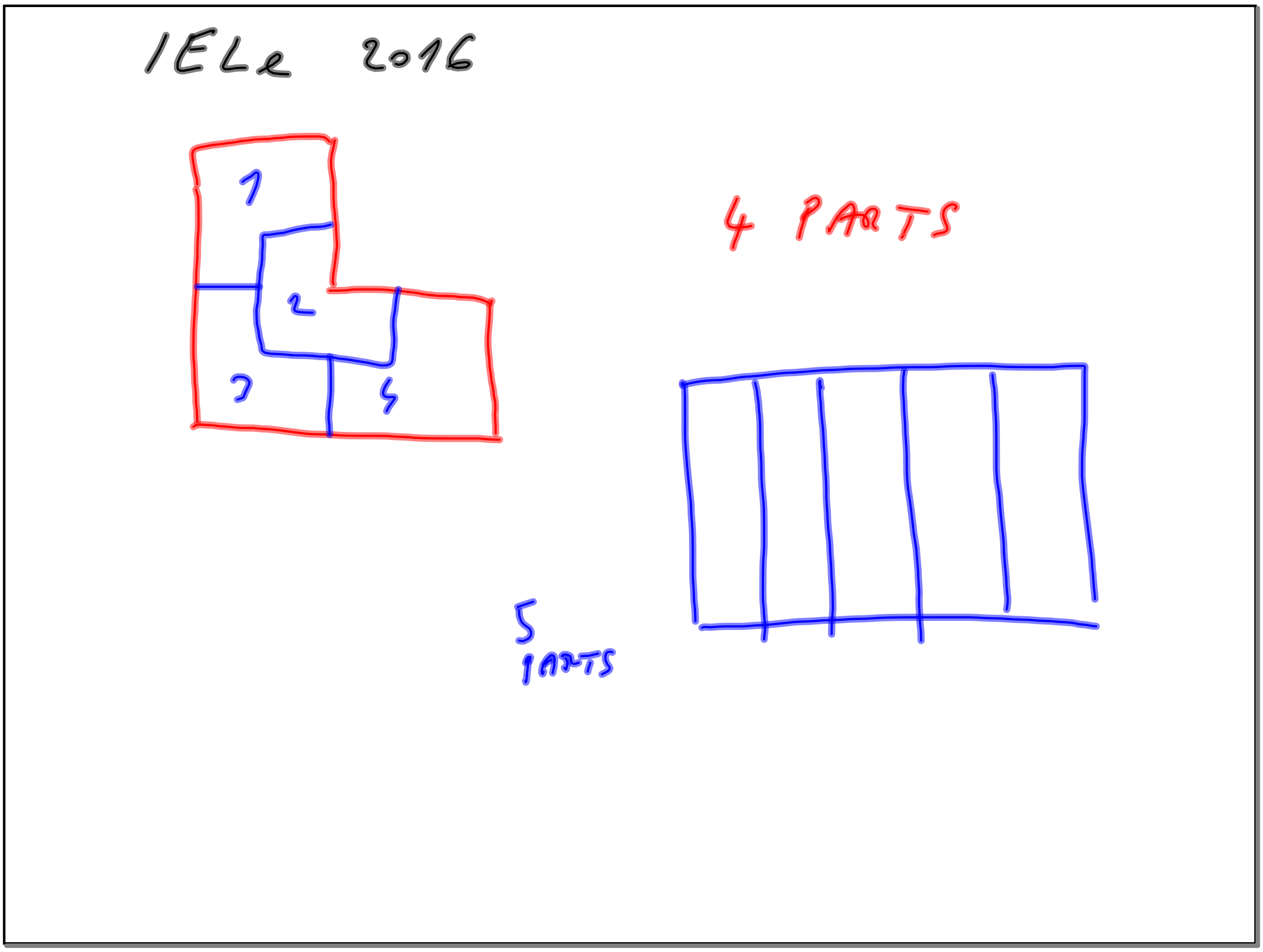
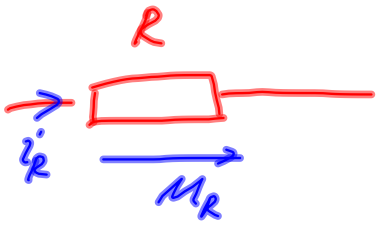
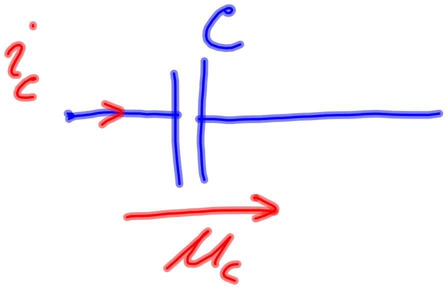

IELe 2016
1
2
3
4
4 PARTS
5 PARTS

RLC CIRCUITS



OHM'S LAW

$$i_R = \frac{u_R}{R}$$



$$u_c' = \frac{1}{C} i_c \qquad u_c' = \frac{du_c}{dt}$$

„OHM'S LAW"

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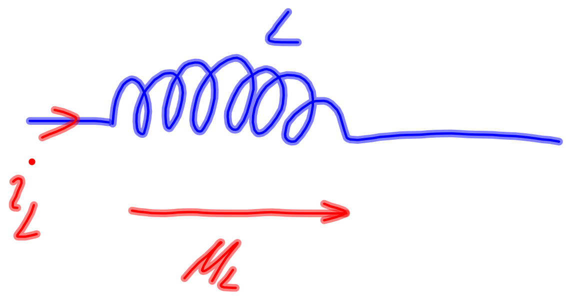
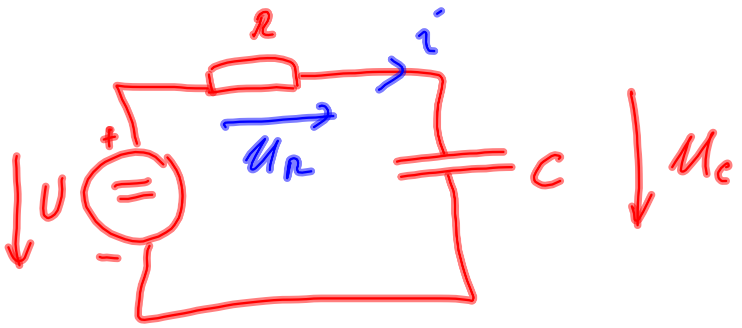


$$i_L' = \frac{1}{L} u_L \qquad i_L' = \frac{d\, i_L}{dt}$$

C and L ARE TIME DEPENDENT



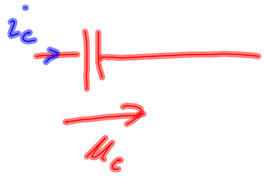
TASK IS TO FIND $u_C = ?$

$u_R = ?$

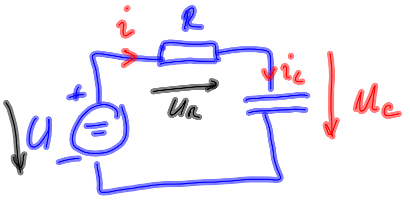
AXIOM 1

$i = ?$

WHEN CIRCUITS CONSITS OF CAPACITANCE THAN WE CONSTRUCT DIFFERENTIAL EQUATION FOR $u_C' = ?$



$$u_c' = \frac{1}{C} i_c$$



$i = i_c$

II. KIRCHHOFF'S LAW

$\sum u$ IN THE CLOSED LOOP $= 0$

$$u_R + u_c - U = 0$$

$$R \cdot i + u_c - U = 0$$

$$i = \frac{U - u_c}{R}$$

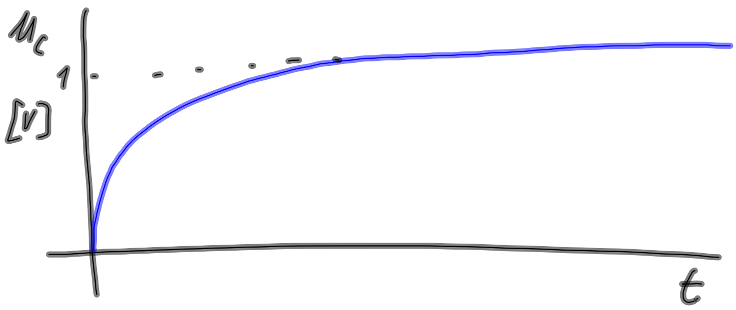
$$u_c' = \frac{1}{C} i \qquad i_c = i$$

$$u_c' = \frac{1}{C} \frac{U - u_c}{R}$$ OK

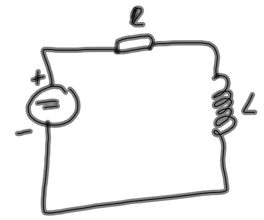
LET $R = 1\,\Omega$ $C = 1F$
$U = 1V$

$$u_c' = 1 - u_c$$

INITIAL CONDITION $u_c(0)$



VERY SIMILAR R – L



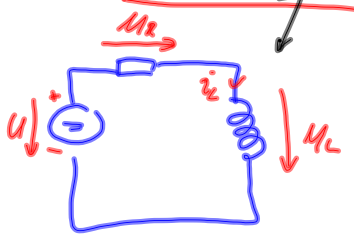
AXIOM 2

WHEN CIRCUIT CONSISTS OF INDUCTANCE WE WILL CONSTRUCT DIFF. EQUATION IN FORM

$$i_L' = ?$$

OHM'S LAW FOR INDUCTANCE

$$i_L' = \frac{1}{L} u_L$$



II. KIRCHHOFF'S LAW FOR CIRCUIT

$$\sum u = 0$$

IN THE LOOP

$$u_R + u_L - U = 0$$

$$R \cdot i_L + u_L - U = 0$$

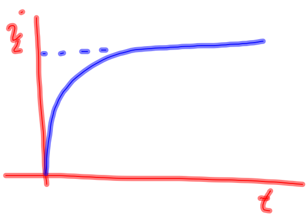
$$u_L = U - R \cdot i_L$$

$$i_L' = \frac{1}{L}\left(U - R \cdot i_L\right)$$ OK ✓

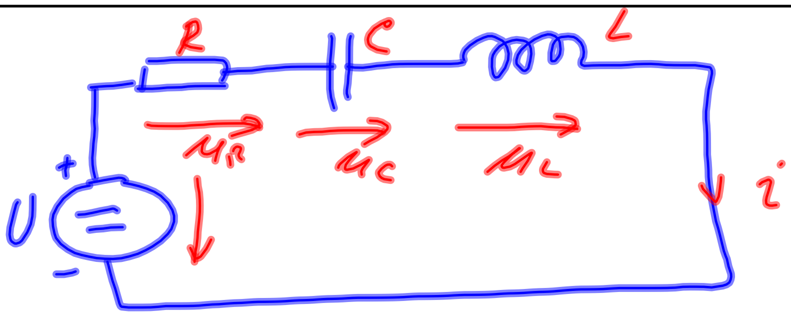
$L = 1H$ $U = 1V$ $R = 1\Omega$

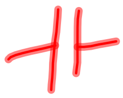
$$i_L' = 1 - i_L$$

$i_L(0) = 0$ — INITIAL CONDITION (FOR EXAMPLE)



($u_C' = 1 - u_C$ ANALYZED FOR CAPACITANCE)





$u_C' = ?$

$i' = ?$

$$u_C' = \frac{1}{C}\, i \qquad \text{I}$$

OK

$$i' = \frac{1}{L}\, u_L$$

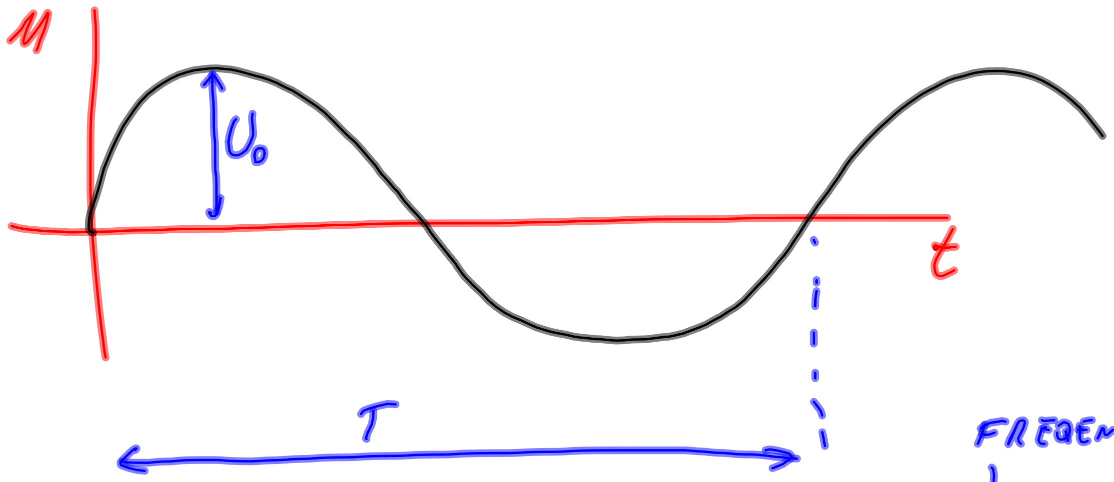
$$u_R + u_L + u_C - U = 0$$

$$u_L = U - u_C - R \cdot i$$

$$i' = \frac{1}{L}\left(U - u_C - R \cdot i\right) \qquad \text{II}$$

R L C ELEMENTS
CONNECTED TO HARMONICAL VOLTAGE SOURCE

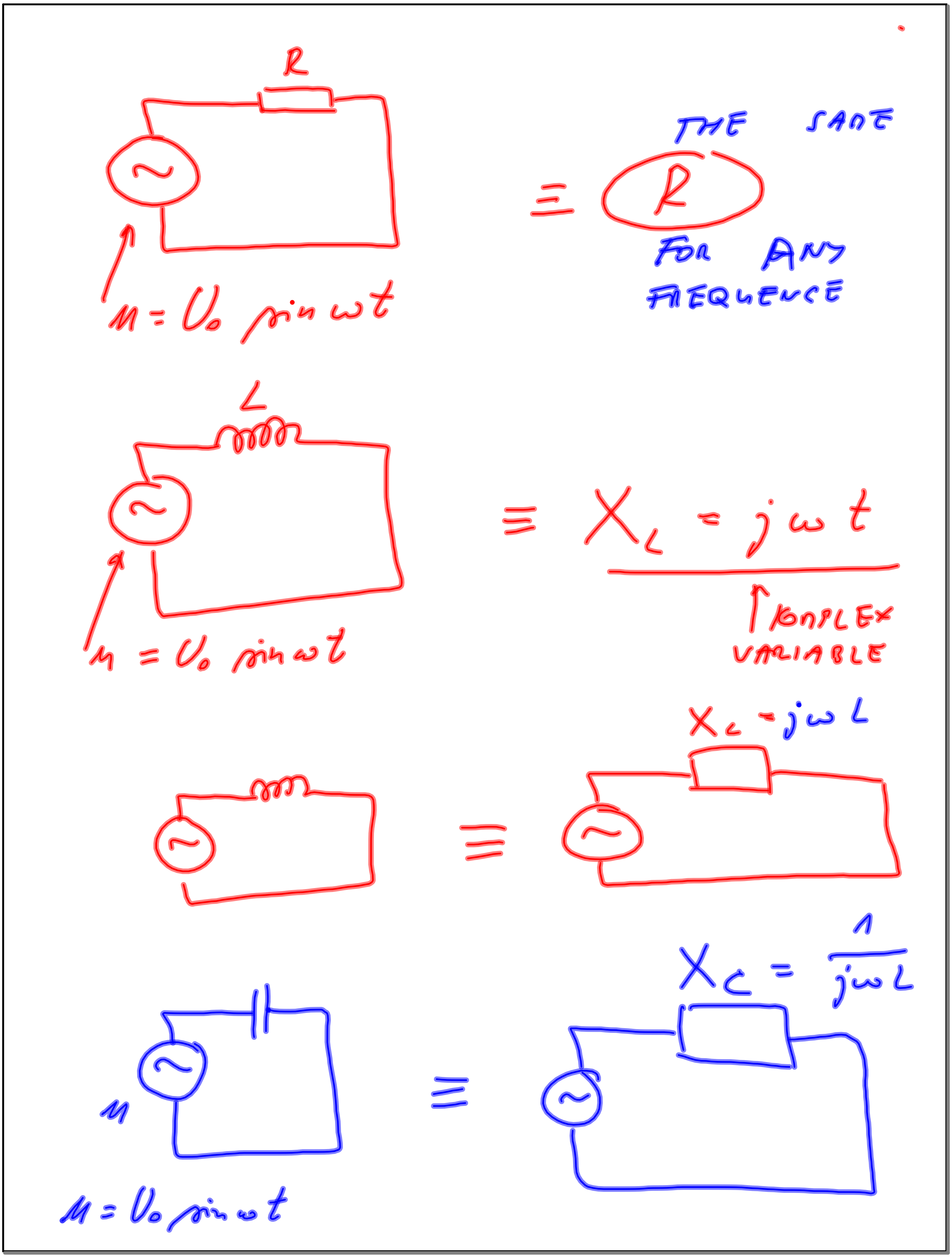
$$u = U_0 \sin \omega t$$



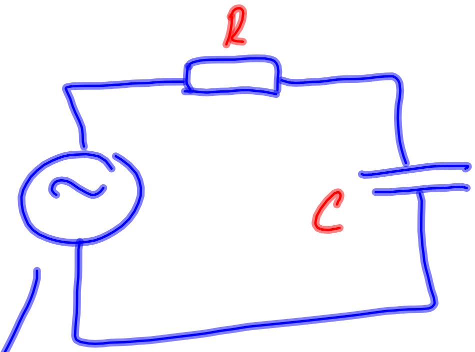
PERIOD

FREQENCE

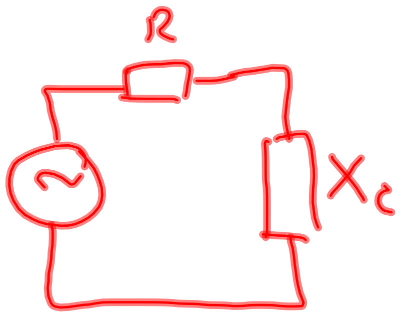
$$\omega = \frac{2\pi}{T} \qquad \omega = 2\pi f$$


R
u = U0 sin ωt
THE SAME
≡ R
FOR ANY FREQUENCE
L
u = U0 sin ωt
≡ XL = jωt
KOMPLEX VARIABLE
XL = jωL
≡
u
u = U0 sin ωt
≡
XC = 1 / jωL

ANALYZE RC CIRCUIT

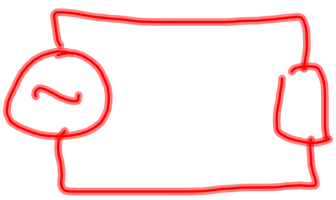


$\Rightarrow$

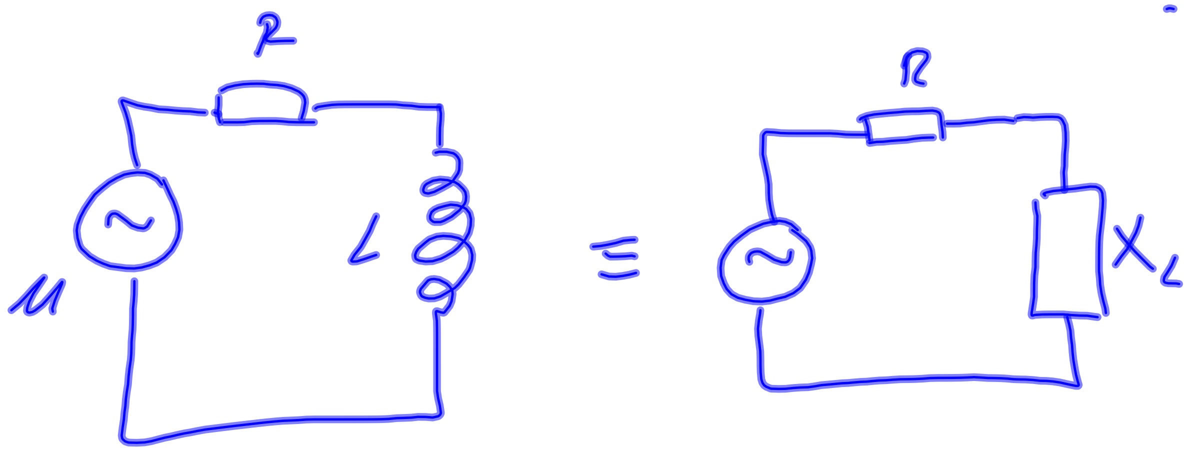


$u = U_0 \sin \omega t$

Z_{EQ}



$$Z_{EQ} = R + \frac{1}{j\omega C}$$



$u = U_0 \sin \omega t$

$X_L = j\omega L$

$Z_{EQ} = R + X_L$

$$Z_{EQ} = R + j\omega L$$

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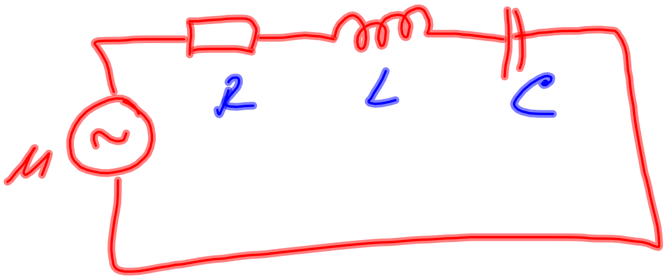
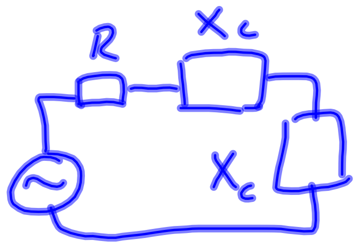


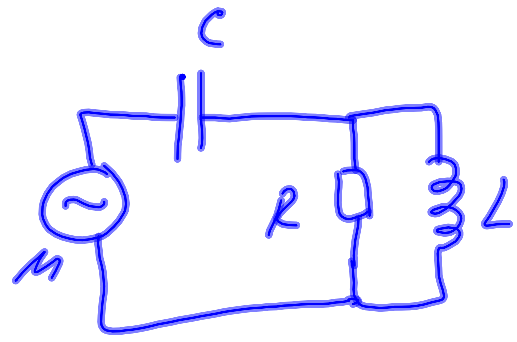
$\equiv$

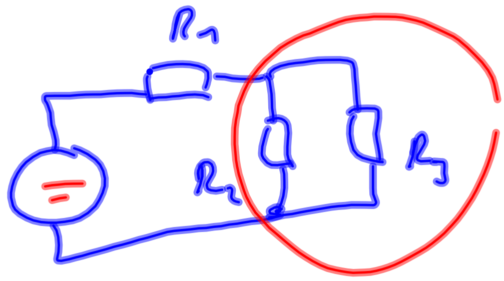


$u = U_0 \sin \omega t$

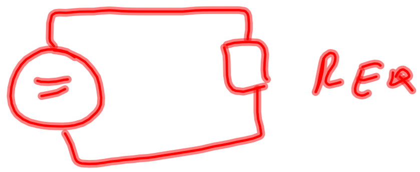
$j \equiv$

$$Z_{EQ} = R + j\omega L + \frac{1}{j\omega C}$$

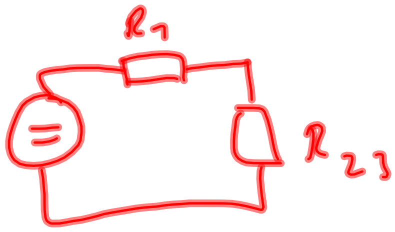


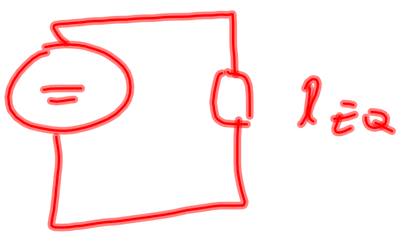


R_{EQ}

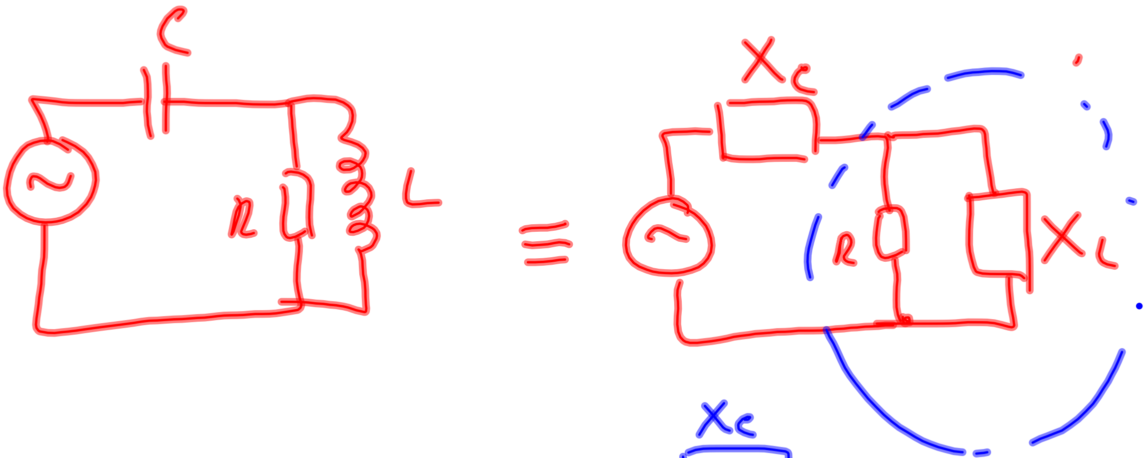


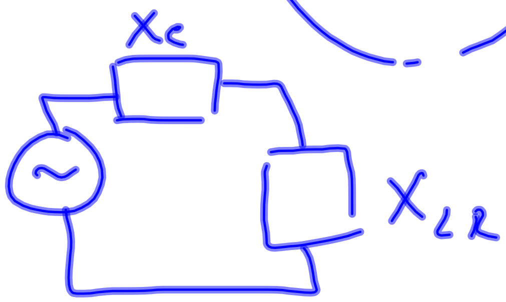
$$R_{13} = \frac{R_1 \cdot R_3}{R_1 + R_3}$$





$$R_{EQ} = R_1 + R_{23}$$





$$X_{LR} = \frac{R \cdot X_L}{R + X_L}$$

$$X_{LR} = \frac{R\, j\omega L}{R + j\omega L}$$

$$Z_{EQ} = X_C + X_{LR}$$

$$Z_{EQ} = \frac{1}{j\omega C} + \frac{R\, j\omega L}{R + j\omega L}$$

$$= A + jB$$

REAL PART (A) — IMAGINARY PART (B)

SW ELECTRONIC CIRCUITS
ANALYSIS

TKSL

SYSTEM
DEFINITION OF DIFF. EQUATION
SYSEND

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