

"Электромагнитные колебания"

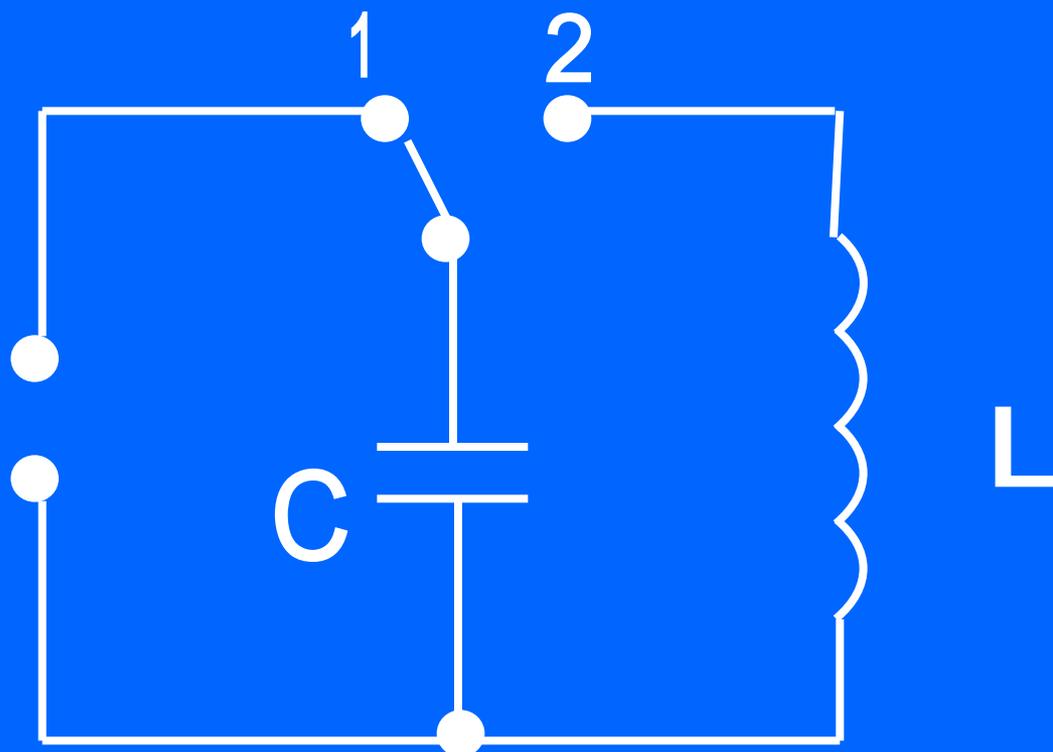
СВОБОДНЫЕ ЭЛЕКТРОМАГНИТНЫЕ КОЛЕБАНИЯ

В КОЛЕБАТЕЛЬНОМ
КОНТУРЕ.

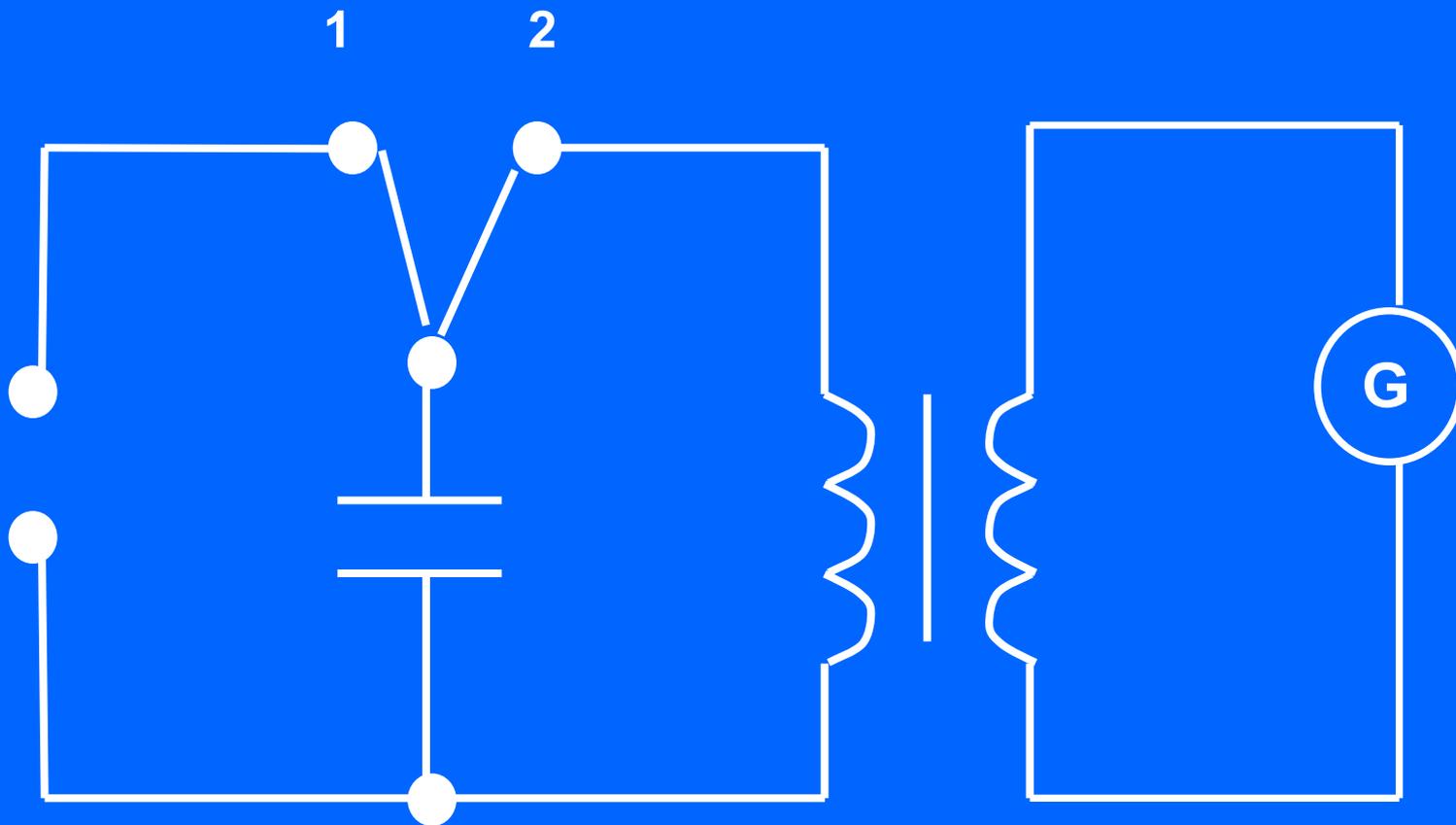
Идеальный колебательный контур



Колебательный контур

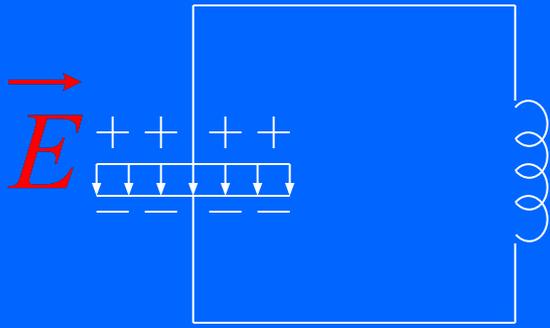


Электромагнитные колебания в контуре



**ПРЕВРАЩЕНИЕ
ЭНЕРГИИ**

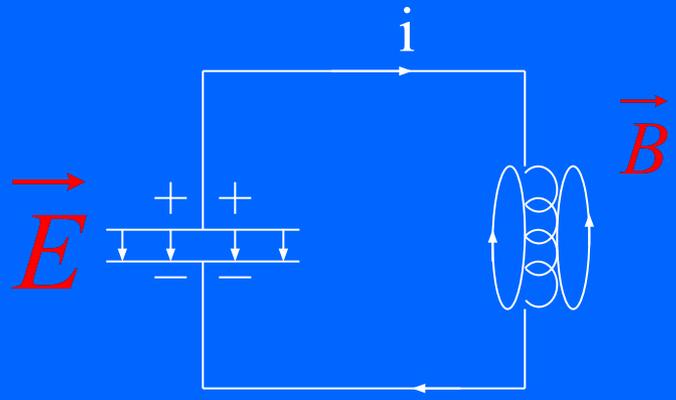
**В
КОЛЕБАТЕЛЬНОМ
КОНТУРЕ.**



$t=0$

$$q = q_m; \quad u_c = U_m; \quad W_{\text{эл}} = \frac{q_m^2}{2C};$$

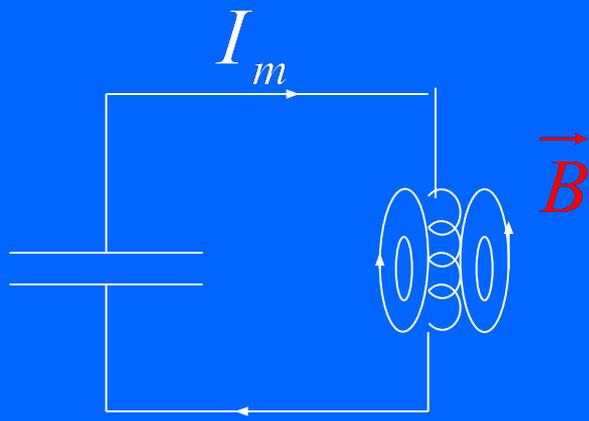
$$i = 0; \quad W_M = 0.$$



$0 < t < \frac{T}{4}$

$$q \downarrow; \quad u_c \downarrow; \quad W_{\text{эл}} = \frac{q^2}{2C};$$

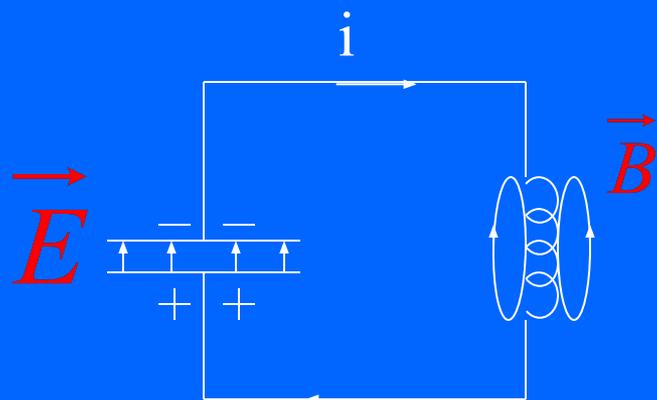
$$i \uparrow; \quad W_M = \frac{Li^2}{2}; \quad W_{\text{эл}} \rightarrow W_M.$$



$t = \frac{T}{4}$

$$q = 0; \quad u_c = 0; \quad W_{\text{эл}} = 0;$$

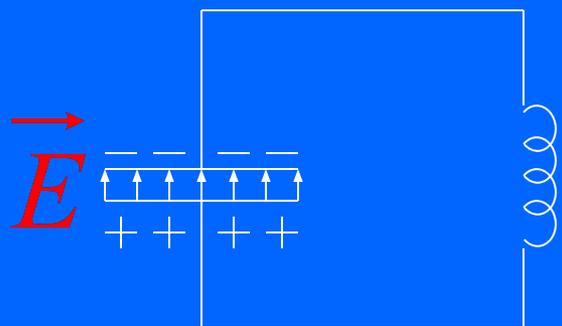
$$i = I_m; \quad W_M = \frac{LI_m^2}{2}.$$



$$\frac{T}{4} < t < \frac{T}{2}$$

$$q \uparrow; u_c \uparrow; W_{\text{эл}} = \frac{q_m^2}{2C};$$

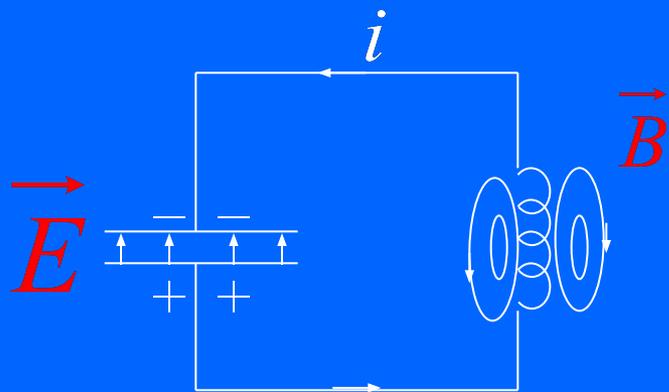
$$i \downarrow; W_M = \frac{LI^2}{2}; W_M \rightarrow W_{\text{эл}}$$



$$t = \frac{T}{2}$$

$$q = q_m; u_c = U_m; W_{\text{эл}} = \frac{q_m^2}{2C};$$

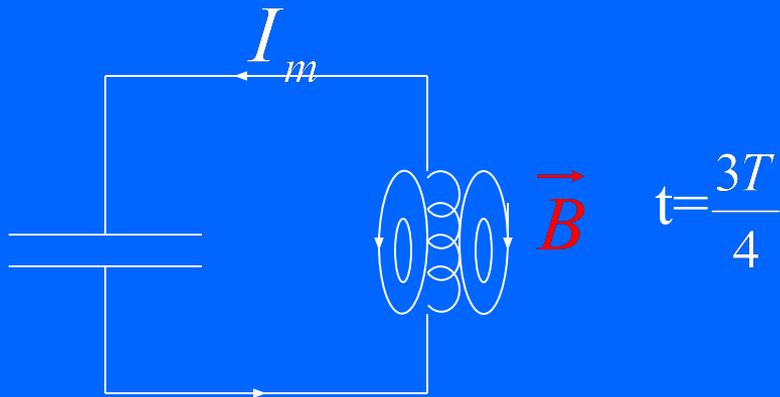
$$i = 0; W_M = 0.$$



$$\frac{T}{2} < t < \frac{3T}{4}$$

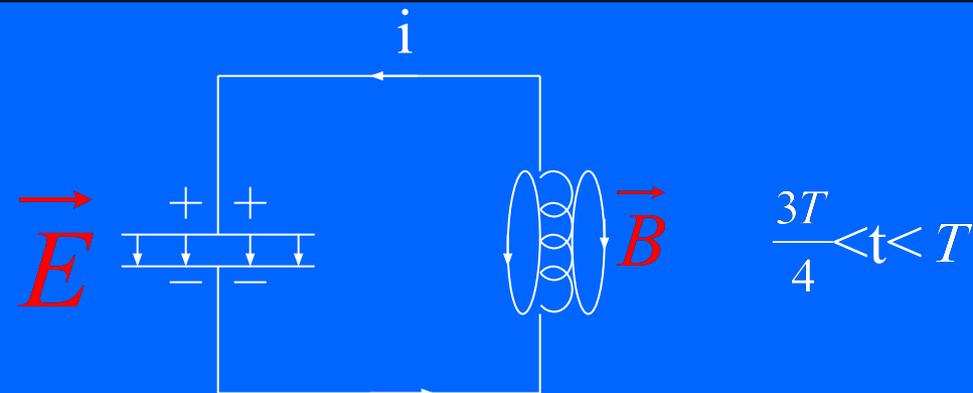
$$q \downarrow; u_c \downarrow; W_{\text{эл}} = \frac{q^2}{2C};$$

$$i \uparrow; W_M = \frac{LI_m^2}{2}; W_{\text{эл}} \rightarrow W_M.$$



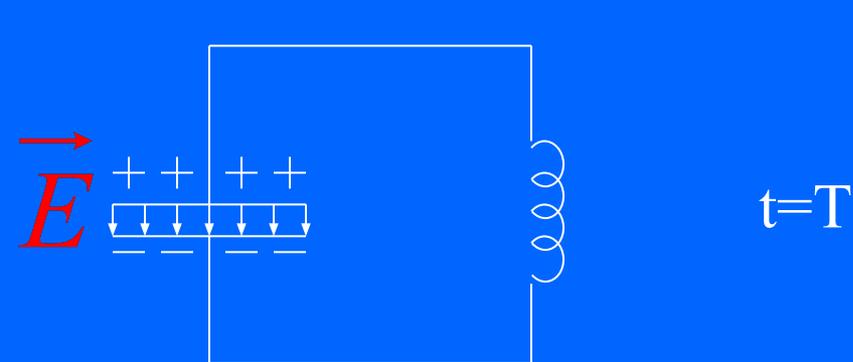
$$q = 0; \quad u_c = 0; \quad W_{\text{эл}} = 0;$$

$$i = I_m; \quad W_M = \frac{LI_m^2}{2}.$$



$$q \uparrow; \quad u_c \uparrow; \quad W_{\text{эл}} = \frac{q^2}{2C};$$

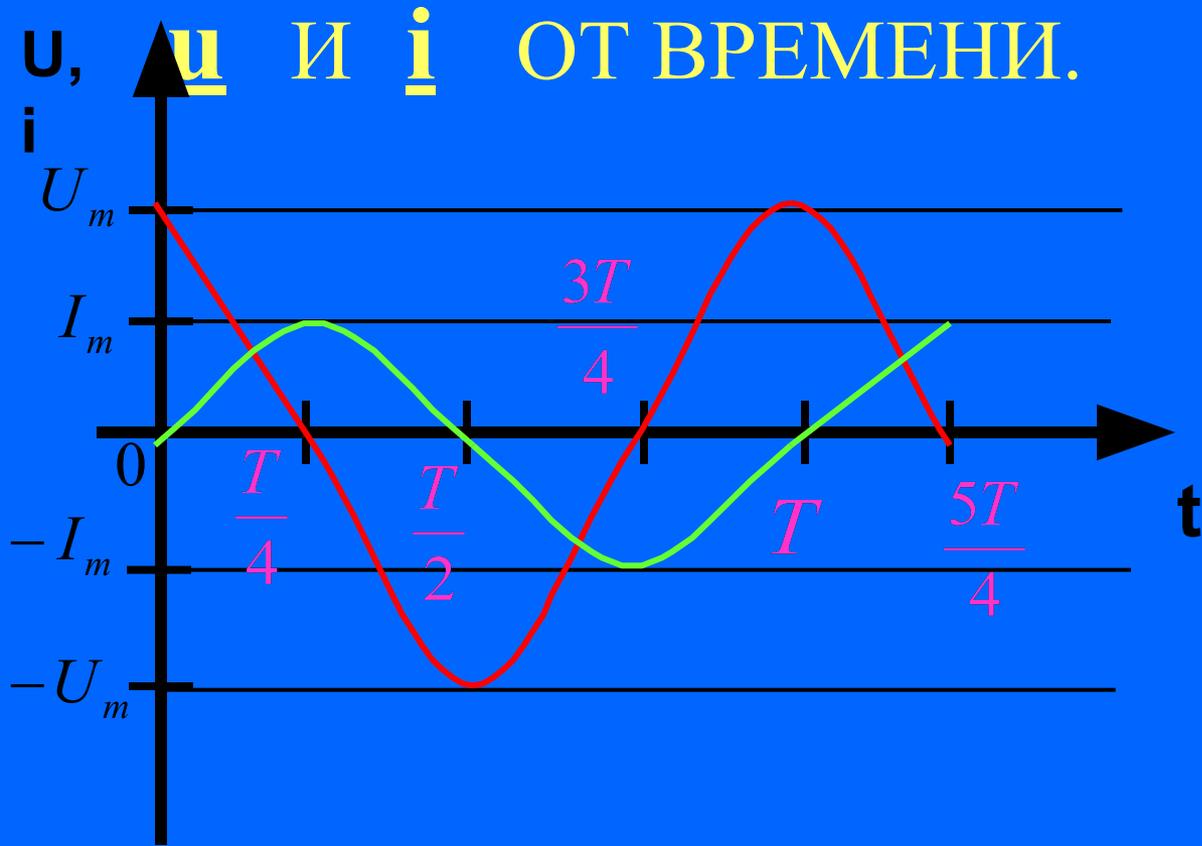
$$i \downarrow; \quad W_M = \frac{Li^2}{2}; \quad W_{\text{эл}} \rightarrow W_M$$



$$q = q_m; \quad u_c = U_m; \quad W_{\text{эл}} = \frac{q_m^2}{2C};$$

$$i = 0; \quad W_M = 0.$$

ЗАВИСИМОСТЬ МГНОВЕННЫХ ЗНАЧЕНИЙ

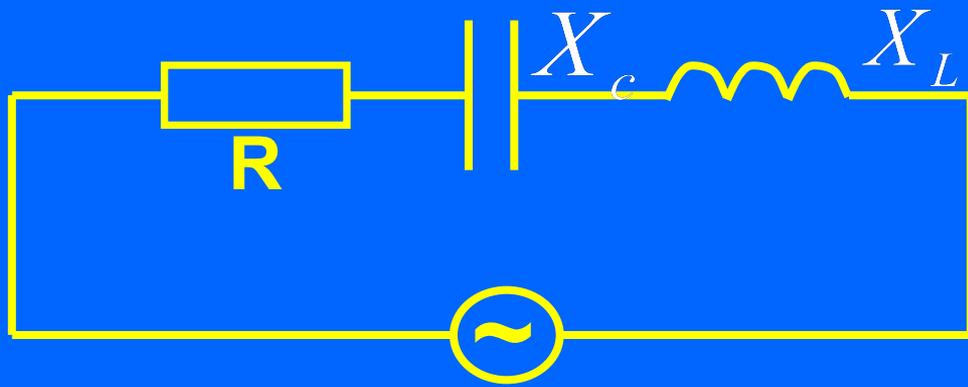


$$u = U_m \cos \omega t;$$

$$i = I_m \cos \left(\omega t - \frac{\pi}{2} \right).$$

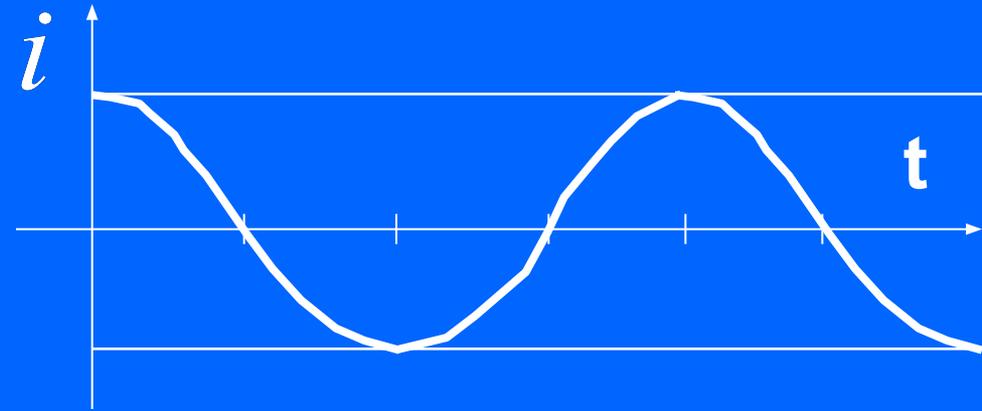
Вынужденные электромагнитные колебания

В колебательном
контуре.



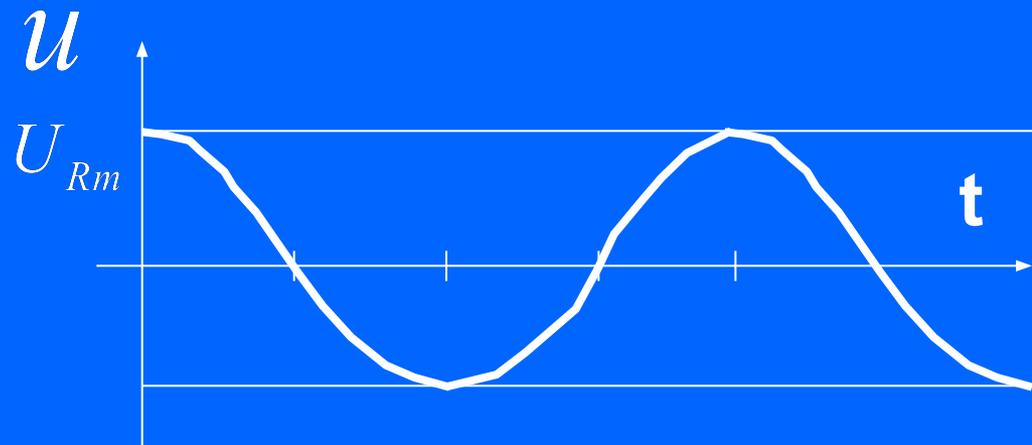
$$i = I_m \cos \omega t;$$

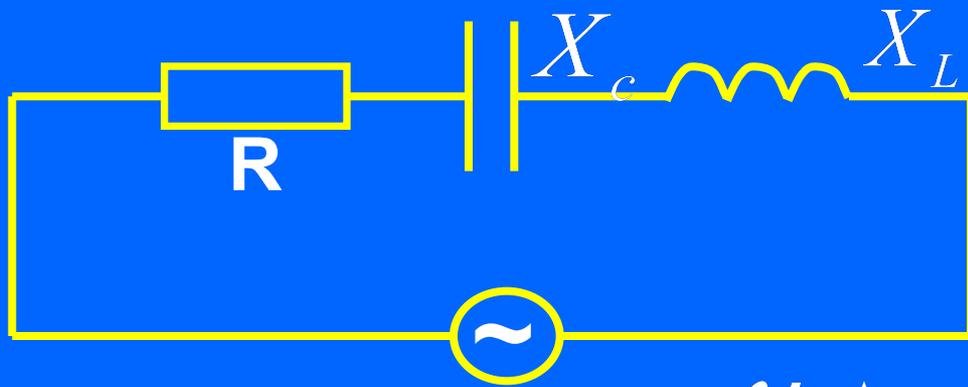
$$U_m = ZI_m;$$



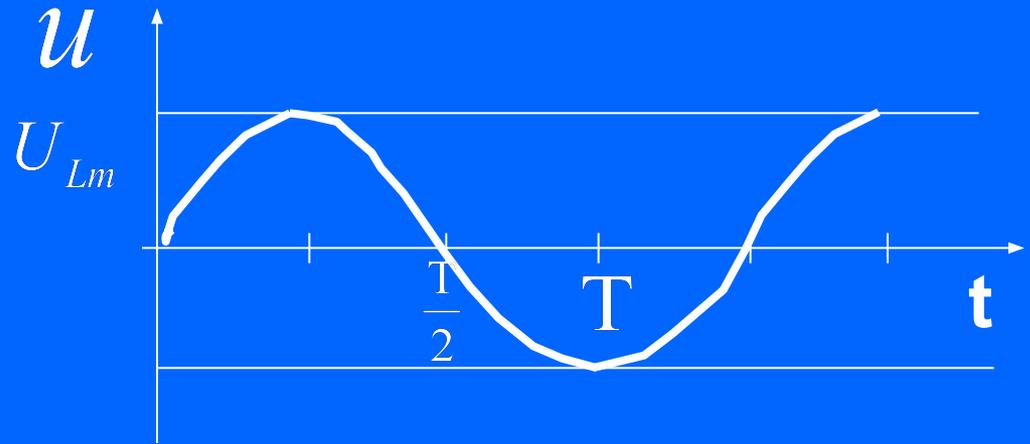
$$u_R = U_{Rm} \cos \omega t;$$

$$U_{Rm} = I_m R.$$



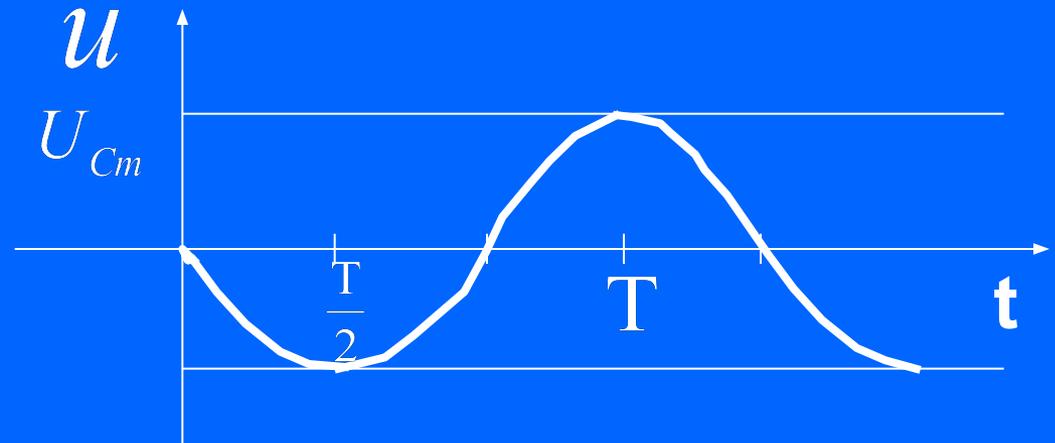


$$u_L = U_{Lm} \cos\left(\omega t + \frac{\pi}{2}\right);$$



$$U_{Lm} = I_m X_L;$$

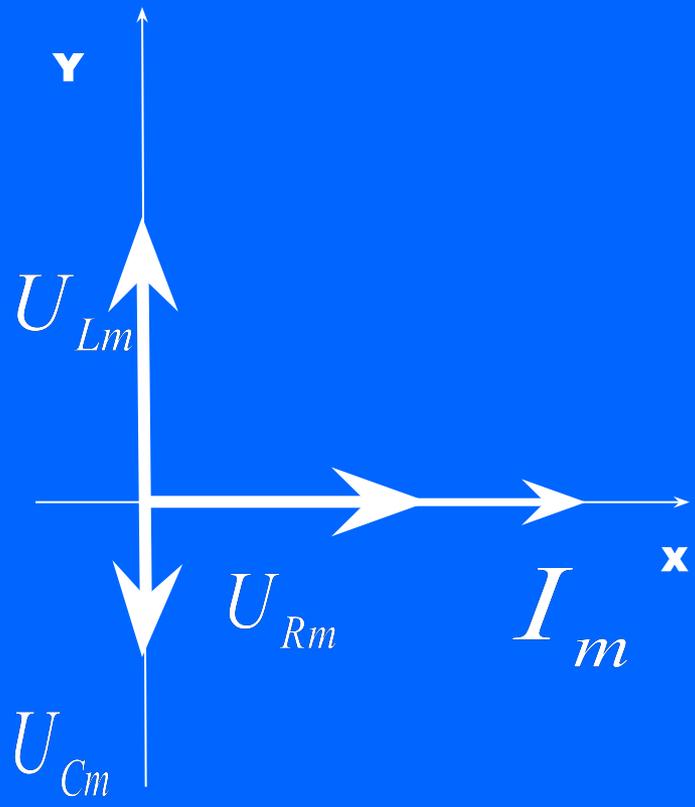
$$u_C = U_{Cm} \cos\left(\omega t - \frac{\pi}{2}\right);$$



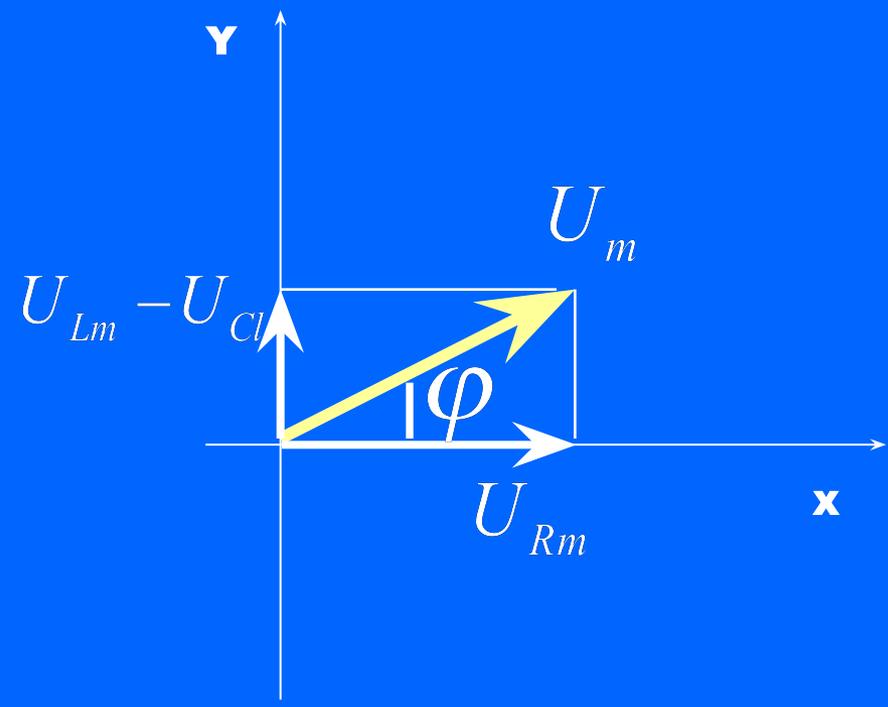
$$U_{Cm} = I_m X_C.$$

Векторная диаграмма колебательного контура

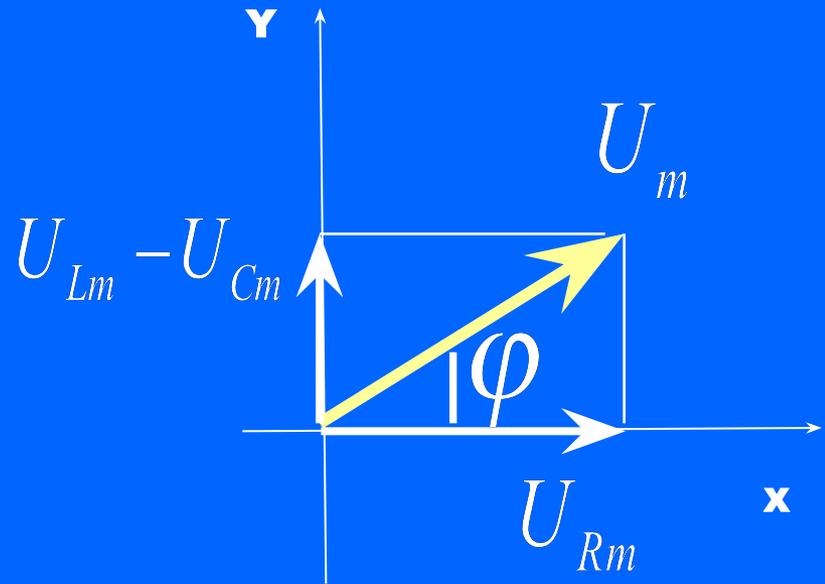
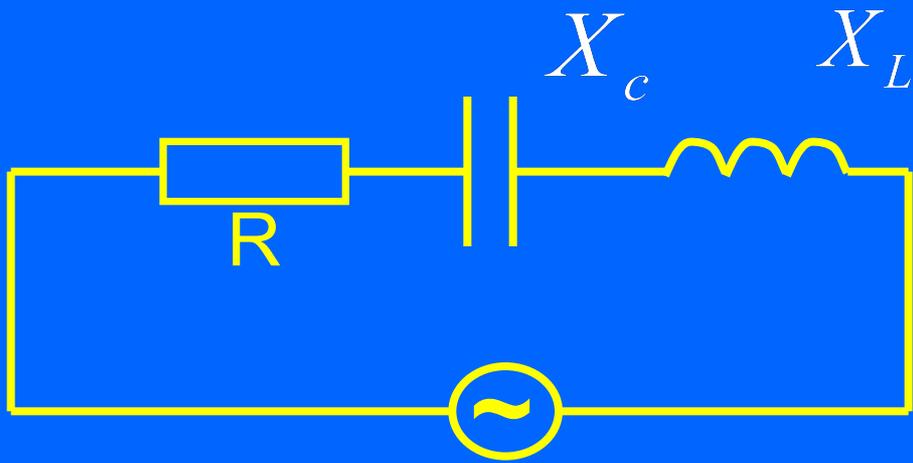
$$U = U_R + U_C + U_L$$



Напряжение на элементах



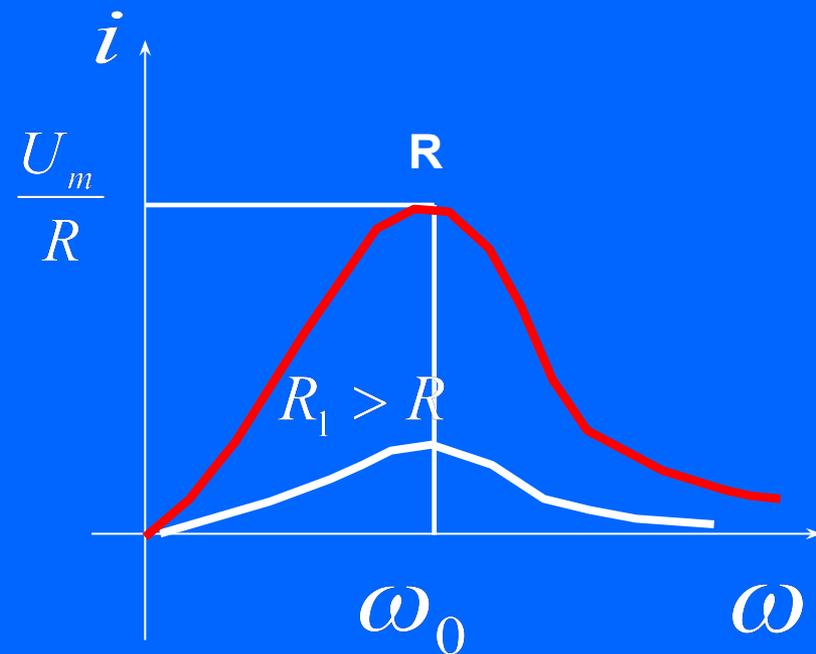
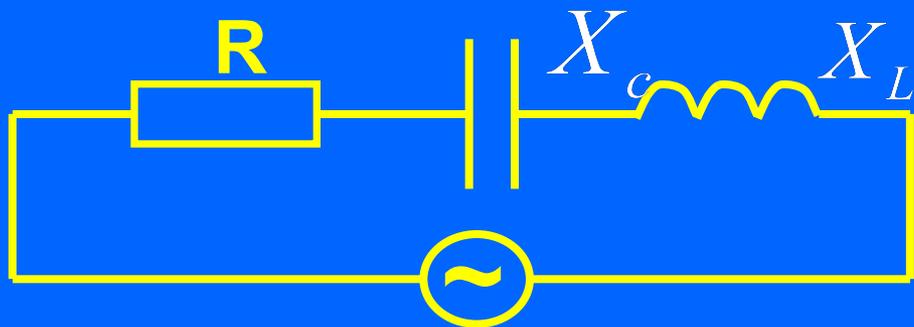
Напряжение приложенное к контуру



$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2};$$

$$\varphi = \operatorname{arctg} \frac{\omega L - \frac{1}{\omega C}}{R}.$$

Резонанс в колебательном контуре



$$\omega = \omega_0;$$

$$\omega_0 = \frac{1}{\sqrt{LC}}; \quad \omega^2 = \frac{1}{LC};$$

$$\omega L = \frac{1}{\omega C} \Rightarrow X_L = X_C$$