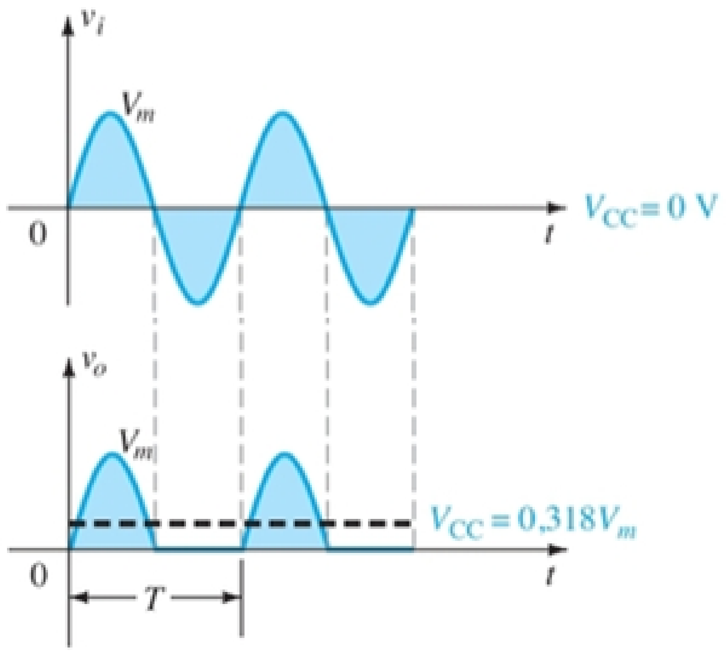
Fator de Ondulação (r)

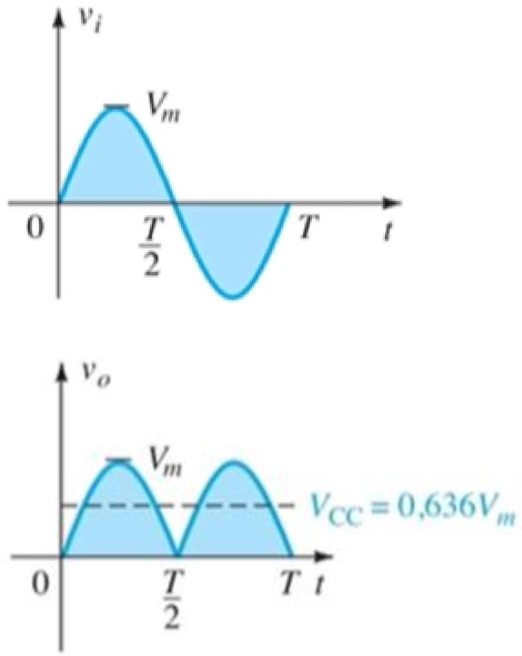
$$r = \frac{\text{valor rms do componente CA do sinal}}{\text{valor médio do sinal}} \Rightarrow r = \frac{V_r(\text{rms})}{V_{CC}}$$



$$V_r(\text{rms}) = \frac{V_M}{2}$$

$$V_{CC} = \frac{V_M}{\pi} = 0.318\ V_M$$

r = 1,57



$$V_r(\text{rms}) = \frac{V_M}{\sqrt{2}}$$

$$V_{CC} = \frac{2V_M}{\pi} = 0{,}636V_M$$

r = 0,48

Fator de Ondulação – Meia Onda e Onda Completa com Filtro Capacitivo

$$r = \frac{\text{valor rms do componente CA do sinal}}{\text{valor médio do sinal}} \Rightarrow r = \frac{V_r(\text{rms})}{V_{CC}}$$

Método 1

$v = v_{CA} + v_{CC} \Rightarrow v_{CA} = v - v_{CC}$

O valor rms da componente CA é dado por:

$$V_{CA}(rms) = \left[\frac{1}{2\pi}\int_0^{2\pi} v_{CA}^2 d\theta\right]$$

$$= \left[\frac{1}{2\pi}\int_0^{2\pi} (v - v_{CC})^2 d\theta\right]^{1/2}$$

$$= \left[\frac{1}{2\pi}\int_0^{2\pi} (v^2 - 2vv_{CC} + v_{CC}{}^2) d\theta\right]^{1/2}$$

$$\frac{1}{2\pi}\int_0^{2\pi} v^2 d\theta = v^2(rms)$$

$$\frac{1}{2\pi}\int_0^{2\pi} 2vv_{CC} d\theta = 2v_{CC}\left(\frac{1}{2\pi}\int_0^{2\pi} v d\theta\right) = 2v_{CC}{}^2$$

(valor médio de v)

$$\frac{1}{2\pi}\int_0^{2\pi} v_{CC}{}^2 d\theta = v_{CC}{}^2$$

$$V_{CA}(rms) = [v^2(rms) - 2v_{CC}{}^2 + v_{CC}^2]^{1/2}$$

$$\Rightarrow V_{CA}(rms) = [v^2(rms) - v_{CC}^2]^{1/2}$$

Retificador de Meia Onda

v_{CC} é constante da Série de Fourier

$$V_{CA}(rms) = [v^2(rms) - v_{CC}^2]^{1/2}$$

$$= \left[\left(\frac{V_m}{2}\right)^2 - \left(\frac{V_m}{\pi}\right)^2\right]^{1/2}$$

$$= V_m\left[\left(\frac{1}{2}\right)^2 - \left(\frac{1}{\pi}\right)^2\right]^{1/2}$$

V_{CA} (rms) = 0.385V_m

Retificador de Onda Completa

v_{CC} é constante da Série de Fourier

$$V_{CA}(rms) = [v^2(rms) - v_{CC}^2]^{1/2}$$

$$= \left[\left(\frac{V_m}{\sqrt{2}}\right)^2 - \left(\frac{2V_m}{\pi}\right)^2\right]^{1/2}$$

$$= V_m\left(\frac{1}{2} - \frac{4}{\pi^2}\right)^{1/2}$$

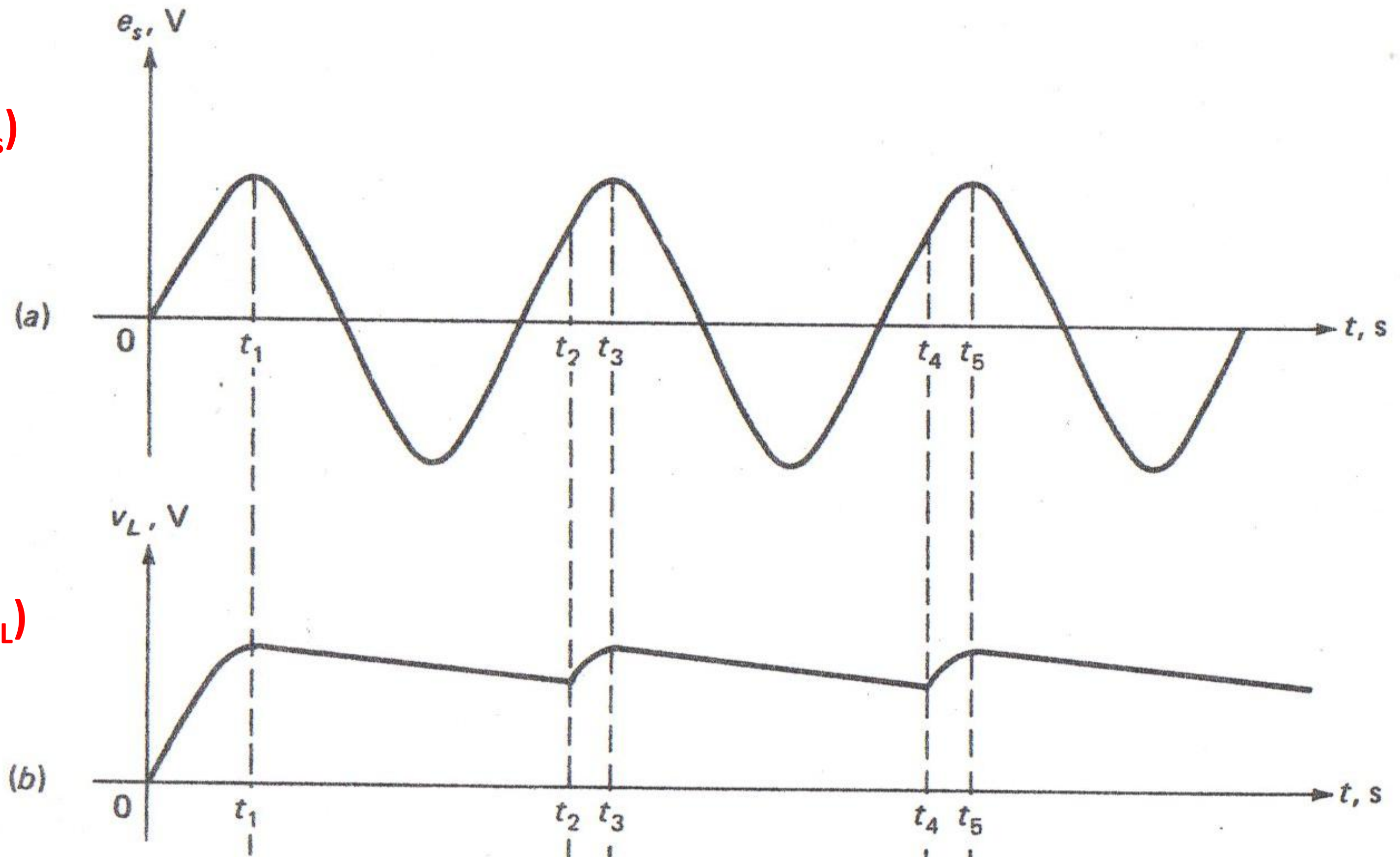
V_{CA} (rms) = 0.308V_m

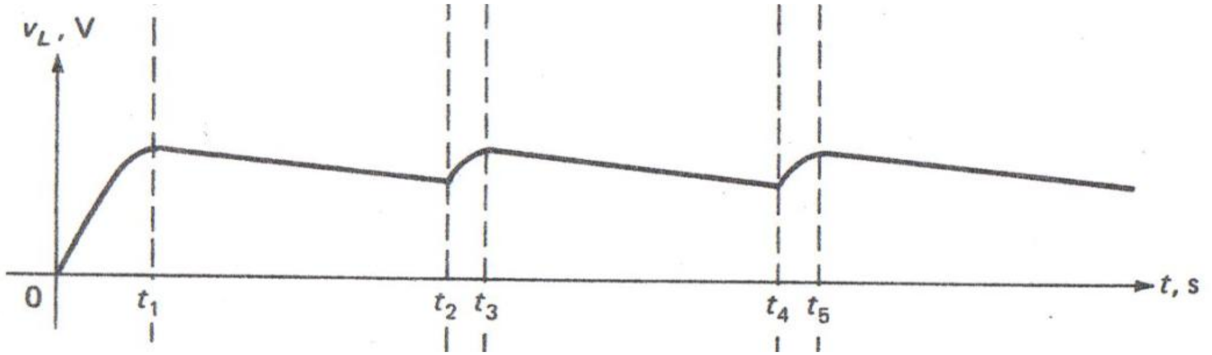
Fator de Ondulação – Meia Onda com Filtro Capacitivo

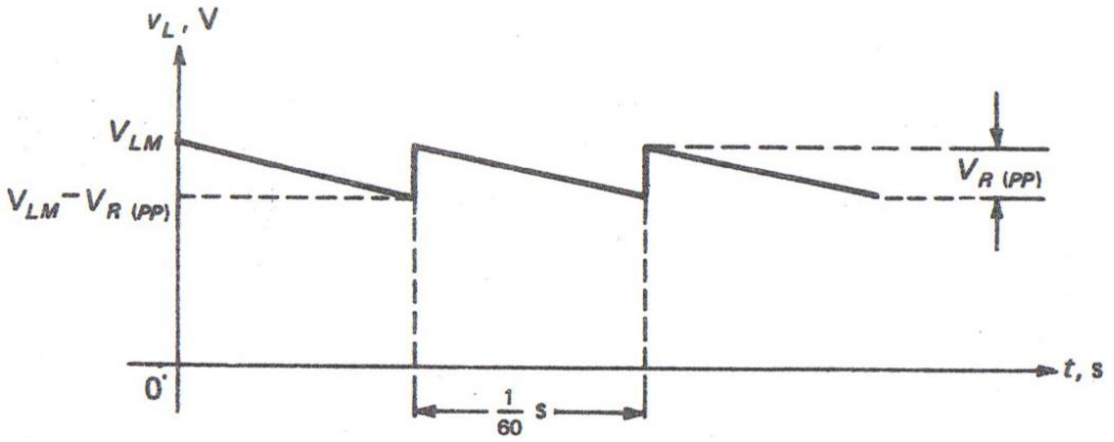
Método 2

tensão de entrada (e_s)

tensão retificada (v_L)





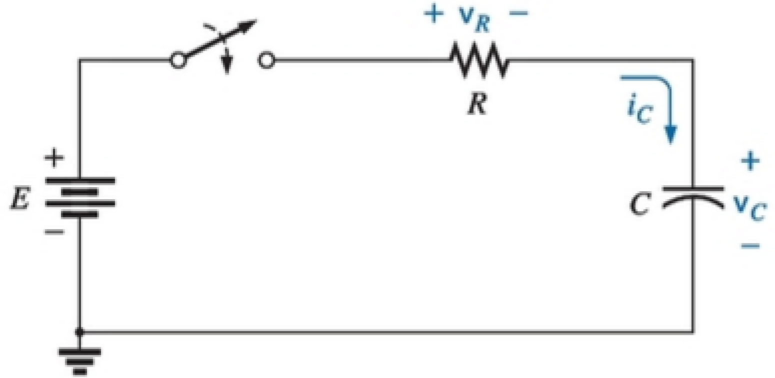


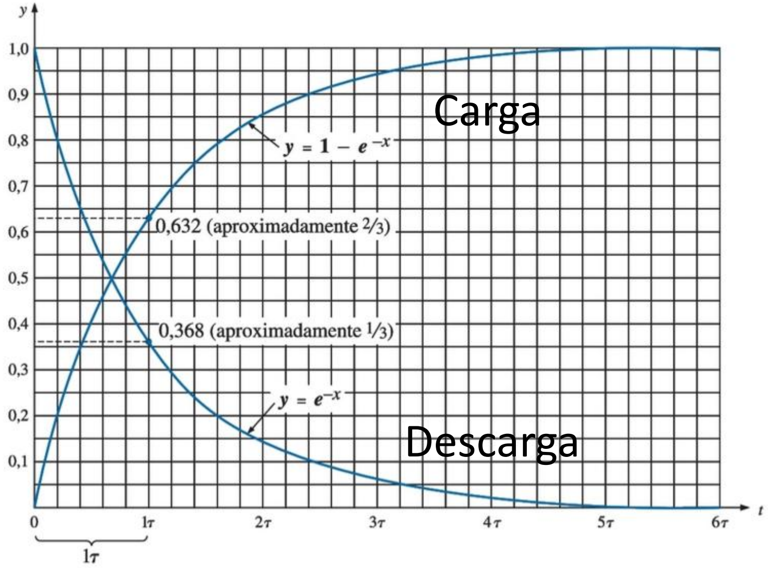
r = ?

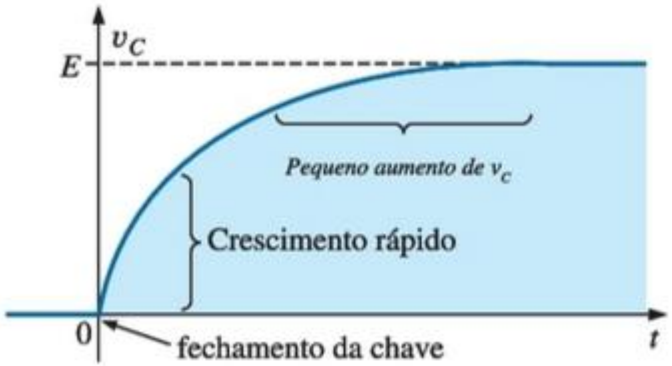
Aproximação do ripple por onda triangular porque $\Delta t = (t_3 - t_2)$ é pequeno

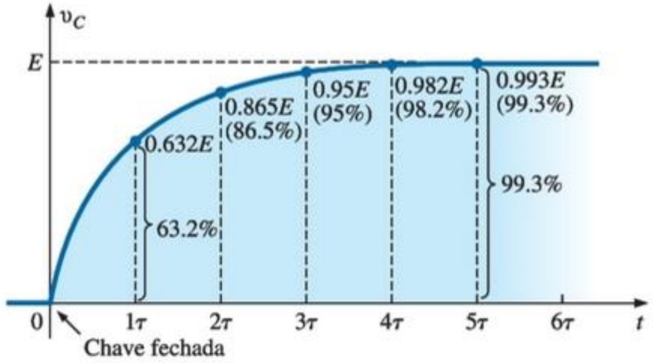
Recordação

Carga de um Capacitor e Constante de Tempo







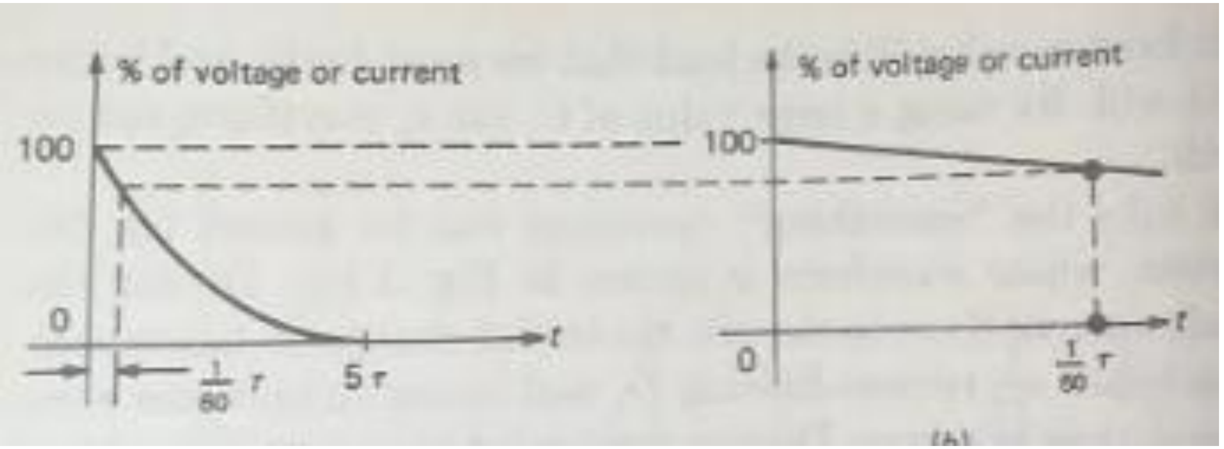


Em $t = 5\tau$

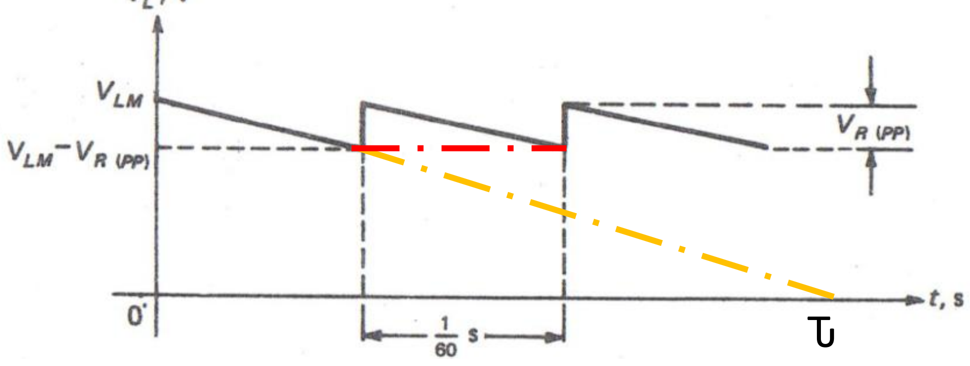
$$e^{-t/\tau} = e^{-5\tau/\tau} = e^{-5} \cong 0{,}007$$

$$v_C = E(1 - e^{-t/\tau}) = E(1 - 0{,}007) = \mathbf{0{,}993}E \cong E$$

- $V_L(\text{DC}) = V_{LM} - 1/2\, V_R(\text{pp})$
- O valor rms de uma dente de serra : $V_{rms} = \frac{V_{pico}}{\sqrt{3}} = \frac{1/2 V_{R(pp)}}{\sqrt{3}}$



A descarga total do capacitor tem duração de 5Ʊ, sendo Ʊ=R_LC. No intervalo de tempo de 1/60 s a exponencial é aproximada por uma reta. Se a descarga do capacitor fosse linear a descarga total ocorreria em um intervalo de tempo Ʊ (s), conforme figura abaixo.



Por semelhança de triângulos:

$$\frac{V_{R(PP)}}{1/60} = \frac{V_{LM}}{\tau} = \frac{V_{LM}}{CR_L} \rightarrow V_{R(PP)} = \frac{V_{LM}}{60CR_L}$$

$$r = \frac{V_{L(AC)rms}}{V_{L(DC)}} = \frac{\frac{1/2V_{R(pp)}}{\sqrt{3}}}{V_{LM} - 1/2\ V_{R(pp)}} \rightarrow r = \frac{T}{2\sqrt{3}\cdot R_L C} = \frac{1}{2\sqrt{3}.fR_L C}$$

Meia Onda Completa

$$\rightarrow r = \frac{T}{4\sqrt{3}\cdot R_L C} = \frac{1}{4\sqrt{3}.fR_L C}$$

Onda Completa