

Formulas for Examination in Power Electronic Converters (ENM060)

Table 3-1 Use of Symmetry in Fourier Analysis

Symmetry	Condition Required	a_n and b_n
Even	$f(-t) = f(t)$	$b_n = 0$ $a_n = \frac{2}{\pi} \int_0^{\pi} f(t) \cos(h\omega t) d(\omega t)$
Odd	$f(-t) = -f(t)$	$a_n = 0$ $b_n = \frac{2}{\pi} \int_0^{\pi} f(t) \sin(h\omega t) d(\omega t)$
Half-wave	$f(t) = -f(t + \frac{1}{2}T)$	$a_n = b_n = 0$ for even h $a_n = \frac{2}{\pi} \int_0^{\pi} f(t) \cos(h\omega t) d(\omega t)$ for odd h $b_n = \frac{2}{\pi} \int_0^{\pi} f(t) \sin(h\omega t) d(\omega t)$ for odd h
Even quarter-wave	Even and half-wave	$b_n = 0$ for all h $a_n = \begin{cases} \frac{4}{\pi} \int_0^{\pi/2} f(t) \cos(h\omega t) d(\omega t) & \text{for odd } h \\ 0 & \text{for even } h \end{cases}$
Odd quarter-wave	Odd and half-wave	$a_n = 0$ for all h $b_n = \begin{cases} \frac{4}{\pi} \int_0^{\pi/2} f(t) \sin(h\omega t) d(\omega t) & \text{for odd } h \\ 0 & \text{for even } h \end{cases}$

Definition of RMS-value:

$$F_{RMS} = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} f(t)^2 dt}$$

Definition of RMS-value with Fourier-series:

$$F_{RMS} = \sqrt{F_0^2 + \sum_{n=1}^{\infty} F_n^2} = \sqrt{\left(\frac{a_0}{2}\right)^2 + \sum_{n=1}^{\infty} \left(\frac{\sqrt{a_n^2 + b_n^2}}{\sqrt{2}}\right)^2}$$

$$\sin^2(\alpha) + \cos^2(\alpha) = 1$$

$$\sin(\alpha + \beta) = \sin(\alpha)\cos(\beta) + \cos(\alpha)\sin(\beta)$$

$$\cos(\alpha + \beta) = \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta)$$

$$\sin(\alpha)\sin(\beta) = \frac{1}{2}(\cos(\alpha - \beta) - \cos(\alpha + \beta))$$

$$\cos(\alpha)\cos(\beta) = \frac{1}{2}(\cos(\alpha - \beta) + \cos(\alpha + \beta))$$

$$\int \sin(ax) dx = -\frac{1}{a} \cos(ax), \quad \int x \sin(ax) dx = \frac{1}{a^2} (\sin(ax) - ax \cos(ax)), \quad \int \cos(ax) dx = \frac{1}{a} \sin(ax)$$

$$\int x \cos(ax) dx = \frac{1}{a^2} (\cos(ax) + ax \sin(ax))$$

$$PF = \frac{P}{S} = \frac{V_s I_{s1} \cos \phi_1}{V_s I_s}, \quad DPF = \cos \phi_1, \quad \%THD_i = 100 \frac{I_{dis}}{I_{s1}} = 100 \frac{\sqrt{I_s^2 - I_{s1}^2}}{I_{s1}} = 100 \sqrt{\sum_{h \neq 1} \left(\frac{I_{sh}}{I_{s1}}\right)^2}$$

Electromagnetics

$$e = \frac{d}{dt} \psi \quad \psi = N\phi \quad \phi = BA \quad R = \frac{l}{A\mu_r\mu_0}$$

$$L = \frac{\Psi}{i}$$

$$NI = R\phi = mmf \quad N\phi = LI \quad L = A_L N^2$$

$$W = \frac{1}{2} LI^2$$

Simpson's rule

Let $f(x)$ be a polynomial of maximum third degree, this means

$$f(x) = a_1 + a_2 x + a_3 x^2 + a_4 x^3$$

For this function the integral can be calculated as

$$\frac{1}{T} \int_{t_0}^{t_0+T} f(x) dx = \frac{1}{6} \left(f(t_0) + 4f\left(t_0 + \frac{T}{2}\right) + f(t_0 + T) \right)$$