Formula sheet for the final exam of Power Electronic Converters (ENM061)

Fourier calculations

Table 3-1 Use of Symmetry in Fourier Analysis

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

Definition of RMS-value:

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

Definition of RMS-value with Fourier-series:

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

Trigonometry

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

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

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

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

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

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

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

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

Electromagnetics

$$e = \frac{d}{dt}\psi \qquad \psi = N\phi \qquad \phi = BA \qquad R = \frac{l}{A\mu_r\mu_0} \qquad L = \frac{\Psi}{i}$$

$$NI = R\phi = mmf \qquad N\phi = LI \qquad L = N^2/R \qquad W = \frac{1}{2}Li^2$$

Capacitor and inductor current-voltage relationship

$$i_C = C\frac{dv_C}{dt} \qquad\qquad v_L = L\frac{di_L}{dt}$$