EN 313 - Power Electronics

Assignment-1

Date: 30-07-2018 Due: 06-08-2018

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1. Consider a generic straight line $y = mx + c$ as shown in Fig. 1. Derive an expression for the area A_{12} (indicated in Fig. 1) in terms of X_1, X_2, Y_1 and Y_2.

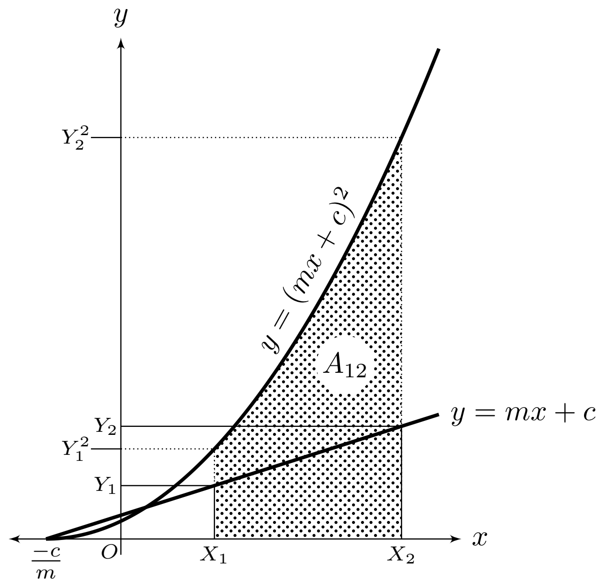

Figure 1: Area under a parabolic section

2. Derive expressions for the RMS values of the periodic waveforms shown in Fig. 2, in terms of the quantities indicated. (Hint: Use the result derived in question 1.)

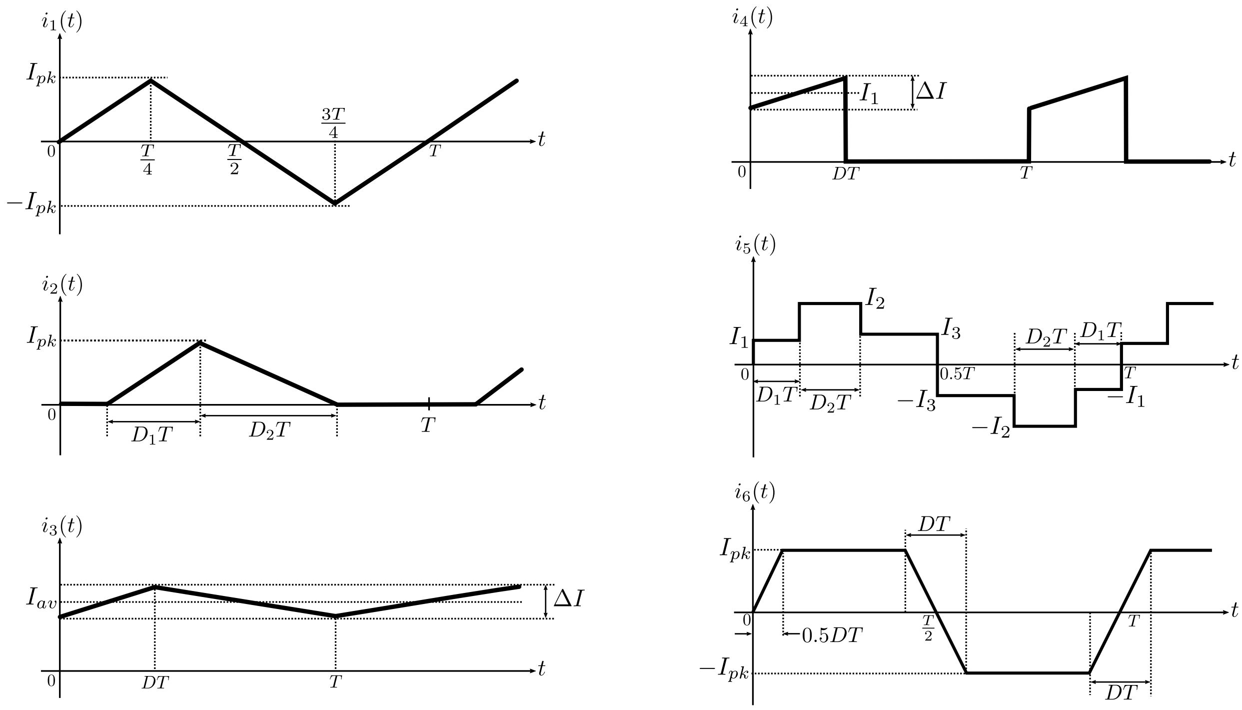

Figure 2: Periodic waveforms

3. Prove that a square wave doesn't contain even harmonics.

4. Consider the Fourier series expansion of a periodic function $f(t)$ given by

$$
\begin{aligned}
f(t) &= a_0 + \sum_{n=1}^{\infty} a_n \cos(n\omega t) + \sum_{n=1}^{\infty} b_n \sin(n\omega t) \\
a_0 &= \frac{1}{T}\int_0^T f(t)\ dt = \frac{1}{2\pi}\int_0^{2\pi} f(t)\ d\omega t \\
a_n &= \frac{2}{T}\int_0^T f(t)\cos(n\omega t)\ dt = \frac{2}{2\pi}\int_0^{2\pi} f(t)\cos(n\omega t)\ d\omega t, \qquad n = 1, 2, 3, ... \\
b_n &= \frac{2}{T}\int_0^T f(t)\sin(n\omega t)\ dt = \frac{2}{2\pi}\int_0^{2\pi} f(t)\sin(n\omega t)\ d\omega t, \qquad n = 1, 2, 3, ...
\end{aligned}
$$

Prove that the mean-square value of $f(t)$ is the sum of (the mean-square value of the fundamental component, the mean-square values of all the harmonics and the square of the average value). Using the above result, find the RMS value of $f(t) = 0.15 + (0.866 \sin \omega t) + (0.5 \cos \omega t) + (0.2 \sin 5\omega t) + (0.4 \sin 7\omega t)$.

5. Determine the order and magnitude of the first four harmonics of the following waveform.