Problem 2.1
(a) Explain why the Fourier series expansion of $i_1(t)$ is of the form

$$i_1(t) = b_1 \sin \omega t + b_3 \sin 3\omega t + b_5 \sin 5\omega t + \ldots$$

(b) Show that, for $n$ odd,

$$b_n = \frac{4I_1}{n\pi} \cos \frac{n\pi}{6}$$

(c) Express $i_1(t)$ using the first five nonzero elements of its Fourier series expansion.

Problem 2.2
(a) Explain why the Fourier series expansion of $i_2(t)$ is of the form

$$i_2(t) = b_1 \sin \omega t + b_3 \sin 3\omega t + b_5 \sin 5\omega t + \ldots$$

(b) Show that, for $n$ odd,

$$b_n = \frac{2I_2}{n\pi} \left(1 + \cos \frac{n\pi}{3}\right)$$

(c) Express $i_2(t)$ using the first five nonzero elements of its Fourier series expansion.

Problem 2.3
(a) Show that

$$I_{1,rms} = I_1 \sqrt{\frac{2}{3}} \quad \text{and} \quad I_{2,rms} = \frac{I_2}{\sqrt{2}}$$

(b) Let $I_1 = 10$ A. Find $I_2$ if $I_{1,rms} = I_{2,rms}$.

(c) Using $I_1 = 10$ A and the value of $I_2$ found in Part (b), express $i(t) = i_1(t) + i_2(t)$ using the first five nonzero terms of its Fourier series expansion.
Problem 2.4

(a) Show that the total harmonic distortion THD\(_1\) of \(i_1(t)\) is

\[
THD_1 = \sqrt{\left(\frac{I_{1,rms}}{b_1/\sqrt{2}}\right)^2 - 1} = \sqrt{\frac{\pi^2}{9}} - 1 \approx 31.1\% \]

where \(b_1 = 2I_1\sqrt{3}/\pi\).

(b) Show that the total harmonic distortion THD\(_2\) of \(i_2(t)\) is

\[
THD_2 = \sqrt{\left(\frac{I_{2,rms}}{b_1/\sqrt{2}}\right)^2 - 1} = \sqrt{\frac{\pi^2}{9}} - 1 \approx 31.1\% \]

where \(b_1 = 3I_2/\pi\).