Average value of a sinusoidal waveform

For a periodic function f(t) with period T,

$$F_{avg} = \frac{1}{T}\int_0^T f(t).dt$$

For sinusoidal current signal,

$$I_{avg} = \frac{1}{(T/2)}\int_0^{T/2} I_m \sin\omega t.dt$$

$$= \frac{I_m}{(T/2)}\left[\frac{-\cos\omega t}{\omega}\Big|_0^{T/2}\right]$$

$$= -\frac{2I_m}{T\omega}\left[\cos\left(\frac{\omega T}{2}\right) - 1\right]$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$\Rightarrow I_{avg} = -\frac{I_m}{\pi}\left[\cos 2\pi - 1\right]$$

$$\boxed{I_{avg} = \frac{2I_m}{\pi}}$$