11-5

a) first wave form

$$i_{RMS} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\,dt}$$

$$= \sqrt{\frac{1}{9}\left(\int_0^3 3^2\,dt + \int_3^6 4^2\,dt\right)}$$

$$= \frac{1}{3}\sqrt{(9+16)\,3}$$

$$= \frac{\sqrt{3}}{3}\sqrt{25}$$

$$\boxed{i_{RMS} = \frac{5\sqrt{3}}{3}A}$$

second wave form

$$i_{RMS} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\,dt}$$

$$= \sqrt{\frac{1}{4}\left(3^2 + (-4)^2\right)}$$

$$= \sqrt{\frac{25}{4}}$$

$$\boxed{i_{RMS} = 2.5A}$$

b) $P = \left(i_{RMS}\,\frac{60}{60+30}\right)^2 30\Omega$

$$P = i_{RMS}^2 \left(\frac{2}{3}\right)^2 30$$

$$= \frac{25}{3}\left(\frac{4}{9}\right)30$$

$$\boxed{P = 111.11\ W}$$

c) $P = i_{RMS}^2 \left(\frac{2}{3}\right)^2 30$

$$(2.5)^2\left(\frac{2}{3}\right)^2 30$$

$$\boxed{P = 83.33\ W}$$

Problem 7

In all parts of the problem, the following identities will be used,

$$\int_0^{2\pi/m} \cos(mnx)\,dx = 0$$
$$\int_0^{2\pi/m} \sin(mnx)\,dx = 0$$

Here m and n are integers.

(a)

$$\begin{aligned}
V_{1eff}^2 &= \frac{1}{T}\int_0^T v_1^2(t)\,dt \\
&= \frac{1}{T}\int_0^T [102 + 40\cos(20t) + 2\cos(40t)]\,dt \\
&= 102 \\
\Rightarrow V_{1eff} &= 10.0995
\end{aligned}$$

(b)

$$\begin{aligned}
V_{2eff}^2 &= \frac{1}{T}\int_0^T v_2^2(t)\,dt \\
&= \frac{1}{T}\int_0^T [50\{1+\cos(4t)\} + 12.5\{1+\cos(8t)\} + 50\{\cos(6t)+\cos(2t)\}]\,dt \\
&= 62.5 \\
\Rightarrow V_{2eff} &= 7.9057
\end{aligned}$$

(c)

$$\begin{aligned}
V_{3eff}^2 &= \frac{1}{T}\int_0^T v_3^2(t)\,dt \\
&= \frac{1}{T}\int_0^T [50\{1+\cos(4t)\} + 36.4277\{1+\cos(8t)\} + 6.2499\{1-\cos(8t)\} + \ldots]\,dt \\
&= 92.6776 \\
\Rightarrow V_{3eff} &= 9.6269
\end{aligned}$$