All questions refer to a power generator producing a voltage of

$$v(t) = 30 + 20\cos(60\pi t + 45°) + 10\cos(120\pi t + 45°)\ \text{V}$$

with an exiting current of

$$i(t) = 6 + 4\cos(60\pi t + 10°) + 2\cos(120\pi t + 120°)\ \text{A}$$

Find: The V_{RMS} of the voltage waveform

$$V_{RMS}^2 = A_D^2 + \frac{1}{2}\sum_{n=1}^{\infty} A_n^2$$
$$= 30^2 + \frac{1}{2}(20^2 + 10^2)$$
$$= 900 + \frac{1}{2}(500)$$
$$= 1150$$
$$V_{RMS} = \sqrt{1150} = \boxed{33.9\ V_{RMS}}$$

Find: The I_{RMS} of the voltage waveform

$$I_{RMS}^2 = 6^2 + \frac{1}{2}(4^2 + 2^2)$$
$$= 46$$
$$I_{RMS} = \boxed{6.78\ A_{RMS}}$$

Find: The total average power delivered by the generator

$$P_{TOTAL} = V_{DC} I_{DC} + \frac{1}{2}\sum_{n=1}^{\infty} V_n I_n \cos(\phi_{Vn} - \phi_{In})$$
$$= (30)(6) + \frac{1}{2}[20.4\cos(35°) + 10.2\cos(-75°)]$$
$$= 180 + 40\cos(35°) + 10\cos(75°)$$
$$= 180 + 32.8 + 2.59$$
$$= \boxed{215\ W}$$

Find: (Real-world) The device is supposed to deliver a pure DC source but it appears to have some contamination from nearby electronic devices. What is the percentage of the total output power contaminated by 60Hz?

$60\ Hz \rightarrow \omega = 2\pi f = 120\pi$

$$P_{60} = \frac{1}{2} V_{60} I_{60} \cos(\phi_{V60} - \phi_{I60})$$
$$= \frac{1}{2} \cdot 10.2\cos(75°)$$
$$= 2.59$$

$$\frac{P_{60}}{P_{TOTAL}} \times 100\% = \frac{2.59}{215} \cdot 100\% = \boxed{1.20\%}$$ 60Hz power contamination