ENGR 203

Homework #7 (Due June 8)

Problem 1.
In the circuit shown below, the Fourier series expansion of $v_s(t)$ is

$$v_s(t) = 3 + \frac{4}{\pi} \sum_{n=1}^{\infty} \frac{1}{n} \sin(n\pi t)$$

Find $v_o(t)$.

Problem 2.
The voltage across the terminals of a circuit is

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

If the current entering the terminal at higher potential is

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

find:
(a) the rms value of the voltage,
(b) the rms value of the current,
(c) the average power absorbed by the circuit.

Problem 3.
A series $RLC$ circuit has $R = 10 \Omega$, $L = 2 \text{ mH}$, and $C = 40 \mu\text{F}$. Determine the effective current and average power absorbed when the applied voltage is

$$v(t) = 100 \cos 1000t + 50 \cos 2000t + 25 \cos 3000t \text{ V}$$

Problem 4.
The periodic current waveform below is applied across a 2-k$\Omega$ resistor. Find the percentage of the total average power dissipation caused by the dc component.
Problem 5.

The amplitude and phase spectra of a truncated Fourier series are shown in the figure below. (a) Find an expression for the periodic voltage using amplitude-phase form. See Eq. (17.10). (b) Is the voltage odd or even function of t?

![Amplitude spectrum](image1)

(a)

![Phase spectrum](image2)

(b)

Problem 6.

Given that

\[
f(t) = \sum_{n=1}^{\infty} \frac{20}{n^2 \pi^2} \cos 2nt - \frac{3}{n\pi} \sin 2nt
\]

plot the first five terms of the amplitude and phase spectra for the function.

Problem 7.

A certain band-limited periodic current has only three frequencies in its Fourier series representation: dc, 50 Hz, and 100 Hz. The current may be represented as

\[i(t) = 4 + 6 \sin 100 \, \pi \, t + 8 \cos 100 \, \pi \, t - 3 \sin 200 \, \pi \, t - 4 \cos 200 \, \pi \, t \, A\]

(a) Express \(i(t)\) in amplitude-phase form.

(b) If \(i(t)\) flows through a 2-Ω resistor, how many watts of average power will be dissipated?