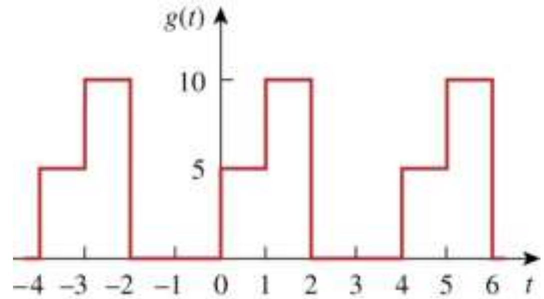


All problems use the following periodic waveform $g(t)$. **For all problems give numeric answers**, e.g. not $2/\pi$ but 0.6366.

**P1** **Concept:** Identify periodic waveform characteristics
**Find:** T, $f_o$, $\omega_o$.

**P2** **Concept:** Fourier Series sin/cos trig decomposition
**Find:** The coefficients $a_0$, $a_1$, $a_2$, $a_3$, $b_1$, $b_2$, $b_3$ so
$a_0 + a_1 \cos(\omega_o t) + b_1 \sin(\omega_o t) + a_2 \cos(2\omega_o t) + b_2 \sin(2\omega_o t) + a_3 \cos(3\omega_o t) + b_3 \sin(3\omega_o t)$
most closely approximates $g(t)$. (They become identical as $n \rightarrow \infty$).
**For *any* credit, the answers must be *numeric*, e.g. not $2/\pi$ but 0.6366.**
**Hints:**
- Solve carefully; the rest of the assignment depends on P2's answer.
- Like CP's, solve for $a_n$, $b_n$ as functions of n first. Then, substitute n=1, 2, 3.
- $a_0$ is between 3 and 4. $a_3$ is 0.53, and $b_3$ is 1.59.

**P3** **Concept:** Fourier Series $A_n \cos(n\,\omega_o\,t + \phi_n)$ trig decomposition
**Find:** The coefficients $A_0$, $A_1$, $A_2$, $A_3$, $\phi_1$, $\phi_2$, $\phi_3$ so that
$A_0 + A_1 \cos(\omega_o t + \phi_1) + A_2 \cos(2\omega_o t + \phi_2) + A_3 \cos(3\omega_o t + \phi_3)$ approximates $g(t)$.
For ***any*** credit, the answers must be numeric, e.g. not $2/\pi$ but 0.6366.
**Hint:**
- $A_1 = 5.02$, and $\phi_1 = -108°$.

**P4** **Concept:** Amplitude spectra, phase spectra
**Find:** Sketch the amplitude spectra and phase spectra of g(t) for $0 \le \omega \le 3\omega_o$. A hand-sketch is fine as long as each plot is fully labeled. Label the ω axis with numbers (e.g. not $2\omega_o$ but 2.52).
**Hints:**
- There is a $A_o$ but no $\phi_o$.
- To plot A=[1, 2.5], w=[0, pi] in Matlab: ≫ stem(w,A)

**P5** **Concept:** Fourier Series synthesis
**Find:** Use any software program to attach a plot of your approximation to $g(t)$ by summing the DC and first three AC harmonics over two periods of the waveform. That is, plot
$A_0 + A_1 \cos(\omega_o t + \phi_1) + A_2 \cos(2\omega_o t + \phi_2) + A_3 \cos(3\omega_o t + \phi_3)$ or
$a_0 + a_1 \cos(\omega_o t) + b_1 \sin(\omega_o t) + a_2 \cos(2\omega_o t) + b_2 \sin(2\omega_o t) + a_3 \cos(3\omega_o t) + b_3 \sin(3\omega_o t)$
(they should be the same thing).
**Hints:**
- It should look grossly similar to $g(t)$. If you computed the Fourier Series components up to n=10 instead of n=2 it would look *very* similar.
- To plot 2 + cos(2 t + 45°) from $0 \le t \le 2.5$ in Matlab:

```
≫ t = linspace(0, 2.5, 1000);  % type "help linspace" to see what it does
≫ g = 2 + cos(2*t + 45*pi/180); % cos takes arguments in radians, not degrees
≫ plot(t,g);  % use title, xlabel, and ylabel to embellish
```