Concept Question 13-7: What distinguishes the phase angles ϕ_n of an even-symmetrical function from those of an odd-symmetrical function?

Even Symmetry: $f(t) = f(-t)$

$$a_0 = \frac{2}{T}\int_0^{T/2} f(t)\,dt,$$

$$a_n = \frac{4}{T}\int_0^{T/2} f(t)\cos(n\omega_0 t)\,dt, \qquad (13.31)$$

$$b_n = 0,$$

$$A_n = |a_n|, \quad \text{and} \quad \phi_n = \begin{cases} 0 & \text{if } a_n > 0, \\ 180^\circ & \text{if } a_n < 0. \end{cases}$$

Odd Symmetry: $f(t) = -f(-t)$

$$a_0 = 0, \qquad a_n = 0,$$

$$b_n = \frac{4}{T}\int_0^{T/2} f(t)\sin(n\omega_0 t)\,dt, \qquad (13.32)$$

$$A_n = |b_n| \quad \text{and} \quad \phi_n = \begin{cases} -90^\circ & \text{if } b_n > 0, \\ 90^\circ & \text{if } b_n < 0. \end{cases}$$

Even symmetry: phase angles are 0 or 180°.
Odd symmetry: phase angles are ±90°.