9.

$$x(t) = |\sin(t)|$$

$\omega_0 = 1 \quad T_0 = 2\pi \longrightarrow \sin(t)$

$T_0 = \pi \longrightarrow |\sin(t)|$, period is half

$\omega_0 = 2 \nearrow$ for absolute $\sin(t)$

$$C_n = \frac{1}{\pi}\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin(t)\, e^{-j2nt}\, dt$$

$$= \frac{1}{\pi}\int_{-\pi/2}^{\pi/2} \frac{e^{jt} - e^{-jt}}{2j}\, e^{-j2nt}\, dt$$

$$\frac{1}{2\pi j} \int_{-\pi/2} e^{jt} e^{-j2nt} - \int_{-\pi/2}^{\pi/2} e^{-jt} e^{-j2nt}$$

$$\frac{1}{2\pi j}\left(\int_{-\pi/2}^{\pi/2} e^{jt - j2nt}\, dt - \int_{-\pi/2}^{\pi/2} e^{-jt - j2nt}\, dt \right)$$

$$\int_{-\pi/2}^{\pi/2} e^{jt(1-2n)} - \int_{-\pi/2}^{\pi/2} e^{jt(-1-2n)}$$

$$= \frac{e^{jt(1-2n)}}{j(1-2n)}\Bigg|_{-\pi/2}^{\pi/2} - \frac{e^{jt(-1-2n)}}{j(-1-2n)}\Bigg|_{-\pi/2}^{\pi/2}$$

$$= \frac{e^{j\frac{\pi}{2}(1-2n)}}{j(1-2n)} - \frac{e^{-j\frac{\pi}{2}(1-2n)}}{j(1-2n)} - \frac{e^{j\frac{\pi}{2}(-1-2n)}}{j(-1-2n)} - \frac{e^{-j\frac{\pi}{2}(-1-2n)}}{j(-1-2n)}$$

$$\frac{1}{j(1-2n)}\left[e^{j\frac{\pi}{2}-jn\pi} - e^{-j\frac{\pi}{2}+jn\pi}\right] - \frac{1}{j(-1-2n)}\left[e^{-j\frac{\pi}{2}-jn\pi} - e^{j\frac{\pi}{2}+jn\pi}\right]$$

$$e^{j\frac{\pi}{2}} = j \ , \ e^{-j\frac{\pi}{2}} = -j$$

$$\frac{1}{j(1-2n)}\left[je^{-jn\pi} + je^{jn\pi}\right] - \frac{1}{j(-1-2n)}\left[-je^{-jn\pi} - je^{jn\pi}\right]$$

$$\frac{1}{2\pi j}\left[\frac{1}{(1-2n)}\left[e^{-jn\pi}+e^{jn\pi}\right] + \frac{1}{(-1-2n)}\left[e^{-jn\pi}+e^{jn\pi}\right]\right]$$

$$\frac{\left(e^{-jn\pi}+e^{jn\pi}\right)}{2\pi j}\left[\frac{1}{(1-2n)} + \frac{1}{(-1-2n)}\right]$$

$$\frac{-1-2n+1-2n}{4n^2-1}$$

$$\frac{-4n\left(e^{-jn\pi}+e^{jn\pi}\right)}{2\pi j\left(4n^2-1\right)}$$

$$e^{-jn\pi}=(-1)^n \quad , \quad e^{jn\pi}=(-1)^n$$

$$\frac{-4n\left(2(-1)^n\right)}{2\pi j\left(4n^2-1\right)}$$

$$\frac{-8n(-1)^n}{2\pi j(4n^2-1)}$$

$$\frac{-4n(-1)^n}{\pi j(4n^2-1)} \quad \frac{(j)}{(j)}$$

$$\boxed{C_n = \frac{4jn(-1)^n}{\pi(4n^2-1)}}$$