EE 370 Homework #1
Solutions

2.3-1 $g_2(t) = g(t-1) + g_1(t-1)$

$g_3(t) = g(t-1) + g_1(t+1)$

$g_4(t) = g(t-\tfrac{1}{2}) + g_1(t+\tfrac{1}{2})$

$g_5(t) = 1.5\, g(0.5t-1)$

2.4-1e $\left(\frac{1}{jw+2}\right)\delta(w+3) = \frac{1}{2-j3}\,\delta(w+3) = (0.15+j0.23)\,\delta(w+3)$

2-8-4d $T_0 = \pi \qquad w_0 = 2$ odd function $\therefore a_n = 0$, $a_n = 0$

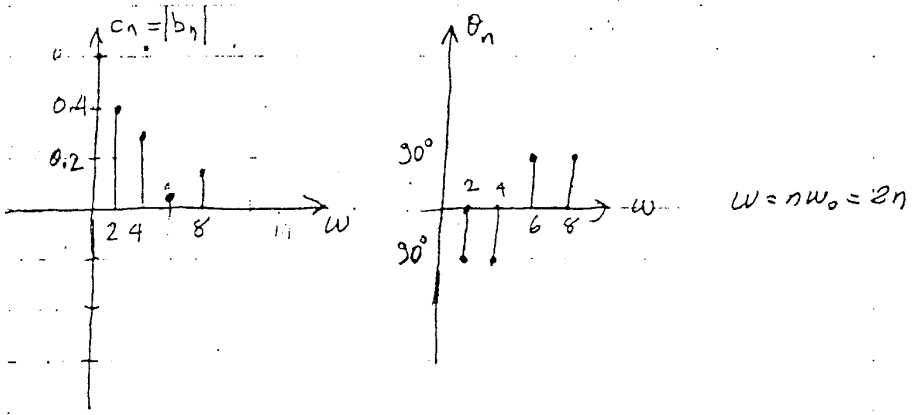
$$b_n = \frac{2}{\pi}\int_{-\pi/4}^{\pi/4} \frac{4}{\pi} t \sin 2nt\, dt = \frac{8}{\pi^2}\frac{-t\cos 2nt}{2n}\Big|_{-\pi/4}^{\pi/4} + \frac{8}{\pi^2}\int_{-\pi/4}^{\pi/4}\frac{\cos 2nt}{2n}\,dt$$

$$b_n = \frac{-4}{\pi^2 n}\left(\frac{\pi}{4}\cos\frac{n\pi}{2} + \frac{\pi}{4}\cos\frac{-n\pi}{2}\right) + \frac{4}{\pi^2 n}\frac{\sin 2nt}{2n}\Big|_{-\pi/4}^{\pi/4}$$

$$= \frac{-2}{\pi n}\cos\frac{n\pi}{2} + \frac{2}{\pi^2 n^2}\left(\sin\frac{n\pi}{2} - \sin\frac{-n\pi}{2}\right) = \frac{4}{\pi^2 n^2}\sin\frac{n\pi}{2} - \frac{2}{n\pi}\cos\frac{n\pi}{2}$$

$$g(t) = \frac{4}{\pi^2}\sin 2t + \frac{1}{\pi}\sin 4t - \frac{4}{9\pi^2}\sin 6t - \frac{1}{2\pi}\sin 8t$$

$$= \frac{4}{\pi^2}\cos\left(2t-\frac{\pi}{2}\right) + \frac{1}{\pi}\cos\left(4t-\frac{\pi}{2}\right) + \frac{4}{9\pi^2}\cos\left(6t+\frac{\pi}{2}\right) + \frac{1}{2\pi}\cos\left(8t+\frac{\pi}{2}\right)$$



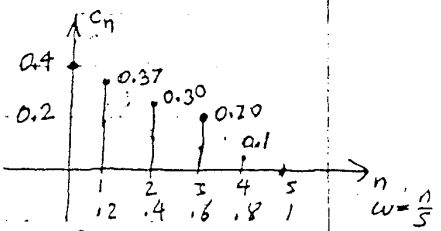
2.9-1(b) $T = 10\pi \qquad \omega_0 = \frac{2\pi}{10\pi} = \frac{1}{5}$

$$D_n = \frac{1}{10\pi}\int_{-\pi}^{\pi} e^{-j\frac{n}{5}t} = \frac{1}{10\pi}\,\frac{e^{-j\frac{n}{5}t}}{-j\frac{n}{5}}\Bigg|_{-\pi}^{\pi} = \frac{1}{n\pi}\,\frac{e^{j\frac{n\pi}{5}} - e^{-j\frac{n\pi}{5}}}{2j}$$

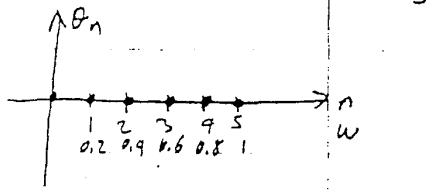
$$D_n = \frac{1}{n\pi}\sin\frac{n\pi}{5} = \frac{1}{5}\,\frac{\sin\frac{n\pi}{5}}{\frac{n\pi}{5}} = \frac{1}{5}\operatorname{sinc}\frac{n\pi}{5} \quad \text{real.}$$

$$g(t) = \sum_{n=-\infty}^{\infty}\left(\frac{1}{5}\operatorname{sinc}\frac{n\pi}{5}\right)e^{j\frac{nt}{5}}$$

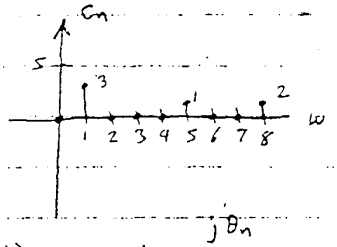
$$c_n = 2|D_n| = \frac{2}{5}\operatorname{sinc}\frac{n\pi}{5}$$

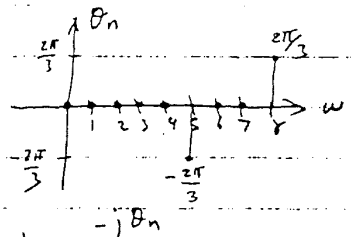


$$\theta_n = \angle D_n = 0$$

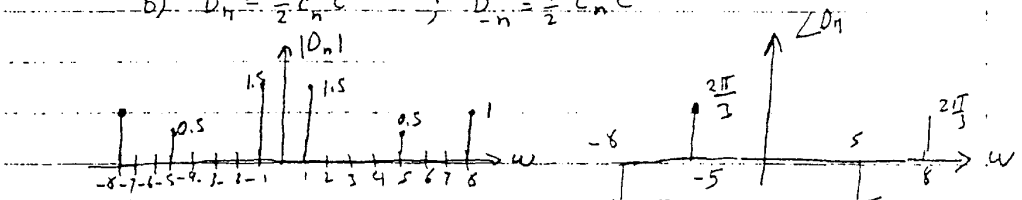


2.9-2





b) $D_n = \frac{1}{2}c_n e^{j\theta_n} \qquad D_{-n} = \frac{1}{2}c_n e^{-j\theta_n}$



c) $g(t) = \frac{3}{2}e^{jt} + \frac{3}{2}e^{-jt} + \frac{1}{2}e^{j(5t-\frac{2\pi}{3})} + \frac{1}{2}e^{-j(5t+\frac{2\pi}{3})} + e^{j(8t+\frac{2\pi}{3})} + e^{-j(8t-\frac{2\pi}{3})}$