Abdurrahman BULUT 1901042258 CSE 351 Final Examination

I hereby pledge that I will strictly adhere to academic integrity codes and the work done on this examination is solely my own and I will not receive /give any help from/to anybody or source during this examination.

**Q1|**

It must be all cos and positive.

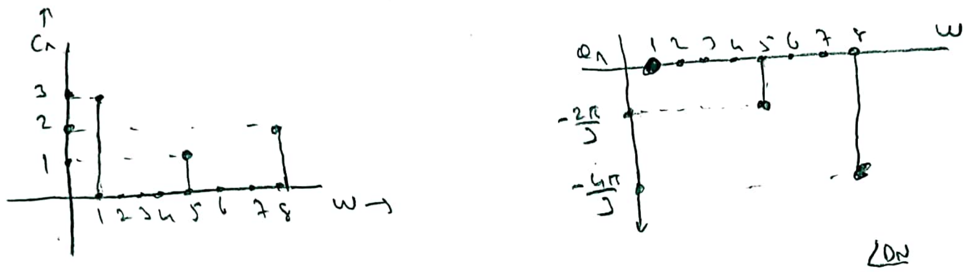
Formula

$\boxed{C_n \cdot \cos(n \cdot \omega_0 t + \theta_n)}$

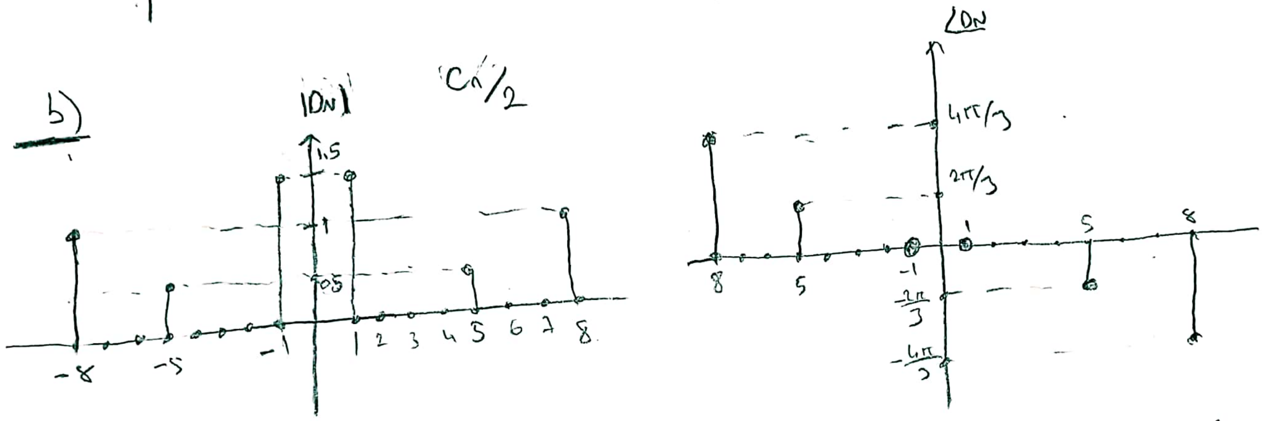
$f(t) = 3\cos(t) + \sin(5t - \frac{\pi}{6} - \frac{\pi}{2}) - 2\cos(8t - \frac{\pi}{3} - \pi)$

$\rightarrow f(t) = 3\cos t + \cos(5t - \frac{2\pi}{3}) + 2\cos(8t - \frac{4\pi}{3})$

a)




b)




c) $f(t) = \frac{3}{2} \cdot (e^{jt} - e^{-jt}) + \frac{1}{2}\left[e^{j(5t - \frac{2\pi}{3})} - e^{-j(5t - 2\pi/3)}\right] + \left[e^{j(8t - \frac{4\pi}{3})} - e^{-j(8t - \frac{4\pi}{3})}\right]$

$f(t) = \frac{3}{2}e^{jt} - \frac{3}{2}e^{-jt} + \frac{1}{2} \cdot e^{-j2\pi/3} \cdot e^{j5t} - \frac{1}{2}e^{j2\pi/3} \cdot e^{-j5t} + e^{j8t} \cdot e^{-4\pi/3} - e^{-j8t} \cdot e^{j4\pi/3}$ //Answer

This is the formula that I used.

$c_n\cos(n\omega_0 t + \theta_n) = \frac{c_n}{2}\left[e^{j(n\omega_0 t + \theta_n)} + e^{-j(n\omega_0 t + \theta_n)}\right]$

Q2)

$g(t) \Leftrightarrow G(w)$

a)

$g(t+T) + g(t-T) \Leftrightarrow 2G(w)\cos(wT)$

Time shifting: $g(t \mp T) = G(w).e^{\pm jwt}$

$G(w).e^{jwt} + G(w).e^{-jwt} = G(w).(e^{jwt} + e^{-jwt})$

$= 2.G(w).\cos(wT)$

b)

$\text{rect}(\frac{t}{\tau}) \Leftrightarrow \tau . Sc.(\frac{w\tau}{2})$ From Table Page 2.

$g(t) = \text{rect}(\frac{t}{2}) \Leftrightarrow 2.\text{sinc}(w)$

Period $= T = 3$

$g(t+3) + g(t-3) \Leftrightarrow 2.\text{sinc}(w).\cos(3w) + 2\text{sinc}(w).\cos(3w)$

$g(t+3) + g(t-3) \Leftrightarrow 4.\text{sinc}(w).\cos(3w)$

Q3) Nyquist sampling $f_s \geq 2B$, $2^N = L$

a) $f_s = 2B$ Hz .. 15 kHz × 2 = 30 kHz sampling rate.

b) $L = 2^N \Rightarrow 65536 = 2^{16} \Rightarrow N = 16$. 16 digits required.

65536/2
32768/2
16384/2
8192/2
4096/2
2048/2
1024 ÷ 2

$65536 = 2^{16}$

c) 30 kHz × 16 = 480000 bits/second

d) N=16.

44100 × 16 = 705600 bits/second

441
× 16
2646
+ 441
7056

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**Q4)** z transform of $x(n) = \cos(w_0 n)\, u(n)$

$$z\{x(n)\} = \sum_{n=-\infty}^{\infty} x(n) . z^{-n}$$


$$= \sum_{n=-\infty}^{\infty} \cos(w_0 n) . \underbrace{u(n)}_{1} . z^{-n}$$

because of u(n) $\longrightarrow$

$$= \sum_{n=0}^{\infty} \cos(w_0 n) . z^{-n}$$

$$\cos(n w_0) = \frac{1}{2} . \left[ e^{j n w_0} + e^{-j n w_0} \right] \text{, so}$$

$$z\{x(n)\} = \sum_{n=0}^{\infty} \frac{1}{2} . \left[ e^{j n w_0} + e^{-j n w_0} \right] . z^{-n}$$

$$= \frac{1}{2} . \left[ \frac{1}{1 - e^{jw} . z} + \frac{1}{z - e^{-jw}} \right] . z^{-n}$$

$(z - e^{-jw}) \quad (z - e^{jw})$

$$= \frac{1}{2} \left[ \frac{z . (z - e^{-jw}) + z . (z - e^{jw})}{(z - e^{-jw}) . (z - e^{jw})} \right]$$

$$= \frac{1}{2} . \left[ \frac{2z^2 - z . (e^{-jw} + e^{jw})}{z^2 - z . (e^{-jw} + e^{jw}) + 1} \right]$$

$$= \frac{z^2 - z . \cos(w)}{z^2 - 2z\cos(w) + 1}$$

**Diğer Yol)**

Or we can use Table 11.1, 11a pair. directly.

$$|r|^k \cos \beta k\, u[k] = \frac{z . (z - |r| . \cos \beta)}{z^2 - (2|r| . \cos \beta) z + |r|^2}$$

$$= \frac{z . (z - \cos w)}{z^2 - (2\cos w) z + 1^2}$$