Homework 9

ECE 2050

9.1

a) $\int_{-\infty}^{2} \left(\frac{\cos(100\pi t + 15°)}{10 - \sin^2(50\pi t)}\right) \delta(t+2.4)\,dt$ ← critical value

≈ 0 if $t \neq -2.4$

$= \left(\frac{\cos(100\pi(-2.4)+15°)}{10 - \sin^2(50\pi(-2.4))}\right) = \boxed{0.095376 = 9.53 \times 10^{2}}$

b) $\int_{-\infty}^{2} \left(\frac{\cos(100\pi t + 15°)}{10 - \sin^2(50\pi t)}\right) \delta(t-2.4)\,dt$ ← critical value = 2.4

$= \frac{\cos(100\pi(2.4)+15°)}{10 - \sin^2(50\pi(2.4))} = \boxed{0.066195 = 6.62 \times 10^{2}}$

c) $\int_{-\infty}^{\infty} e^{j\omega t} \left(\sum_{k=-\infty}^{\infty} \left(\frac{7}{4}\right)^{-|k|} \delta\left(\omega - \frac{2\pi k}{5}\right)\right) d\omega$ ← critical value = $\frac{2\pi k}{5}$

$\boxed{= e^{j\left(\frac{2\pi k}{5}\right)t} \left(\sum_{k=-\infty}^{\infty} \left(\frac{7}{4}\right)^{-|k|}\right)}$

d) $\int_{-\pi}^{\pi} \frac{\sin(9\hat{\omega})}{\sin(\hat{\omega}/2)} \delta(\hat{\omega} + 0.75\pi)\,d\hat{\omega}$ ← critical value = -0.75π

$\frac{\sin(9(-0.75\pi))}{\sin\left(\frac{-0.75\pi}{2}\right)} = \boxed{17.5931}$

e) $\int_{-\pi}^{\pi} \frac{\sin(9\hat{\omega})}{\sin(\hat{\omega}/2)} \left(\sum_{k=-\infty}^{\infty} \delta(\hat{\omega} + 0.75\pi - 2\pi k)\right) d\hat{\omega}$ ← critical value = $2\pi k - 0.75\pi$

$\boxed{= \frac{\sin(9(2\pi k - 0.75\pi))}{\sin((2\pi k - 0.75\pi)/2)}}$

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9.21

a) $x_a[n] = (1.25e^{j0.25\pi})^{3-n} u[n-3]$

$X_a(e^{j\omega}) = \frac{1}{1-(1.25e^{j0.25\pi}X(e^{j\omega}))} = \boxed{\frac{1}{1-(1.25e^{j0.25\pi - j\omega})}}$

b) $x_b[n] = rect(\frac{n-4}{16})$

$\boxed{X_b(e^{j\omega}) = \frac{\sin(\frac{9\omega}{2})}{\sin(\frac{\omega}{2})}}$

c) $x_c[n] = rect(\frac{n-4}{16})\delta[n-10]$ → $X(e^{j\omega}) \cdot 10$

$\boxed{X_c(e^{j\omega}) = 10\frac{\sin(\frac{9\omega}{2})}{\sin(\frac{\omega}{2})}}$

d) $x_d[n] = rect(\frac{n-4}{16})\delta[n-10]$ → $X(e^{j\omega}) = 10$

$\boxed{X_d(e^{j\omega}) = 10\frac{\sin(\frac{9\omega}{2})}{\sin(\frac{\omega}{2})}}$

e) $x_e[n] = (2.5)^{3-n}\cos(0.25\pi n)u[n-3]$

$\boxed{X_e(e^{j\omega}) = \frac{\pi}{1-2.5e^{-j3\omega}} \sum_{q=-\infty}^{\infty} (\delta(\omega-0.25-2\pi q) + \delta(\omega+0.25-2\pi q))}$

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9.3

a) $\hat{X}_a(e^{j\hat{\omega}}) = \sum_{k=-\infty}^{\infty} e^{j7\hat{\omega}}\left[\delta(\hat{\omega} + \frac{7\pi}{8} - 2\pi k) + \delta(\hat{\omega} - \frac{7\pi}{8} - 2\pi k)\right]$ $\quad \omega_0 = -\frac{7\pi}{8}$

$$\boxed{x_a[n] = 7^n \cos\left(-\frac{7\pi}{8} n\right)}$$

b) $\hat{X}_b(e^{j\hat{\omega}}) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.17\pi}\right)$

$x_b[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} \text{rect}\left(\frac{\hat{\omega}}{0.17\pi}\right) d\hat{\omega} \rightarrow$ $\boxed{= \frac{1}{2\pi} \text{ from } -\hat{\omega}_{max} \text{ to } \hat{\omega}_{max}}$

c) $\hat{X}_c(e^{j\hat{\omega}}) = 1 - \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.35\pi}\right)$

$\hat{\omega}_{max}$ is greatest val to allow rect() = 1

$x_c[n] = 1 - \frac{1}{2\pi}\int_{-\pi}^{\pi} \text{rect}\left(\frac{\hat{\omega}}{0.35\pi}\right) d\hat{\omega} \rightarrow$ $\boxed{= 1 - \frac{1}{2\pi} \text{ from } -\hat{\omega}_{max} \text{ to } \hat{\omega}_{max}}$

d) $\hat{X}_d(e^{j\hat{\omega}}) = e^{j7\hat{\omega}} \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.85\pi}\right)$

$x_d[n] = e^{j7\omega}\int_{-\pi}^{\pi} \text{rect}\left(\frac{\hat{\omega}}{0.85\pi}\right) d\hat{\omega} \rightarrow$ $\boxed{= \frac{1}{2\pi}\delta[n-7] \text{ from } -\hat{\omega}_{max} \text{ to } \hat{\omega}_{max}}$

e) $\hat{X}_e(e^{j\hat{\omega}}) = \cos(7\hat{\omega}) + 1 = \frac{e^{j7\hat{\omega}} + e^{-j7\hat{\omega}}}{2} = \frac{1}{2}\left(e^{j7\hat{\omega}} + e^{-j7\omega}\right)$

$$\boxed{x_e[n] = \frac{1}{2}\left(\delta[n-7] + \delta[n+7]\right)}$$

9.4 $h[n] = \overbrace{4(0.55)^{n-3}u[n]}^{f[n]} - \underbrace{0.5(-0.25)^n u[n-3]}_{g[n]}$

$\hat{H}(e^{j\omega}) = \hat{F}(e^{j\omega}) - \hat{G}(e^{j\omega})$

$\hat{F}(e^{j\omega}) = \frac{24.0421}{1 - 0.55e^{-j\omega}} \qquad \hat{G}(e^{j\hat{\omega}}) = \frac{32e^{-j\omega 3}}{1 + 0.25e^{-j\omega}}$

$\hat{H}(e^{j\hat{\omega}}) = \frac{24.0421}{1 - 0.55e^{-j\omega}} - \frac{32e^{-j\omega 3}}{1 + 0.25e^{-j\omega}} \rightarrow$ $\boxed{\hat{H}(z) = \frac{24.04}{1 - 0.55z^{-1}} - \frac{32z^{-3}}{1 + 0.25z^{-1}}}$

Figure 1

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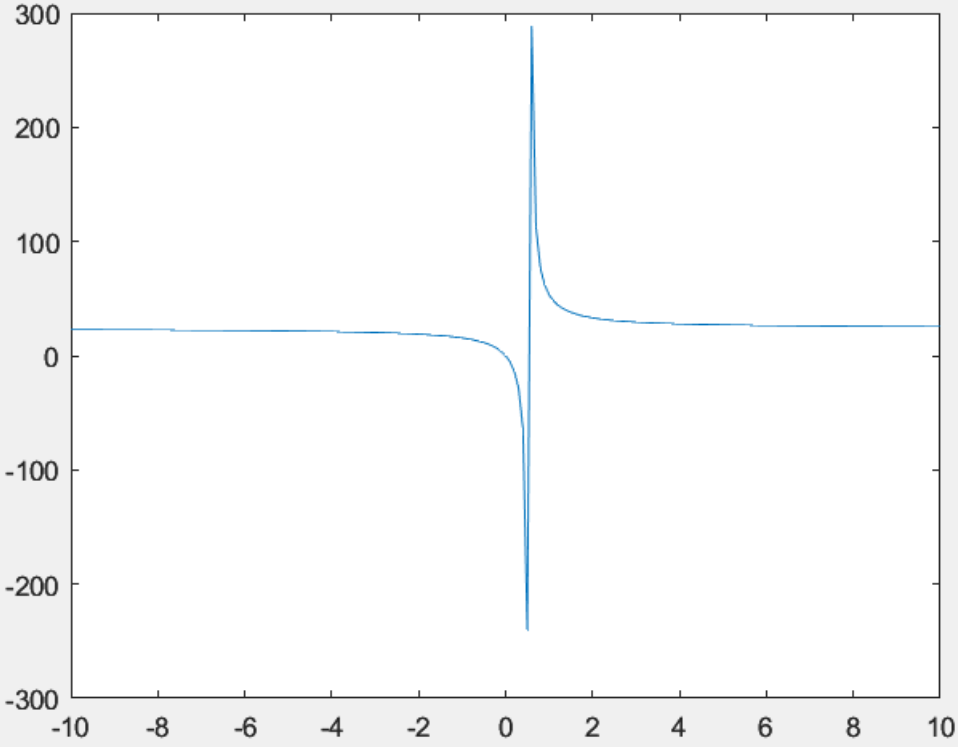

Homework9.m

```
1   z = -10:0.1:10;
2
3   f = 24.0421./(1-0.55*z.^(-1));
4
5   g = (32*z.^-3)/(1+0.25*z.^-1);
6
7   plot(z,f-g);
```