Assignment No.1

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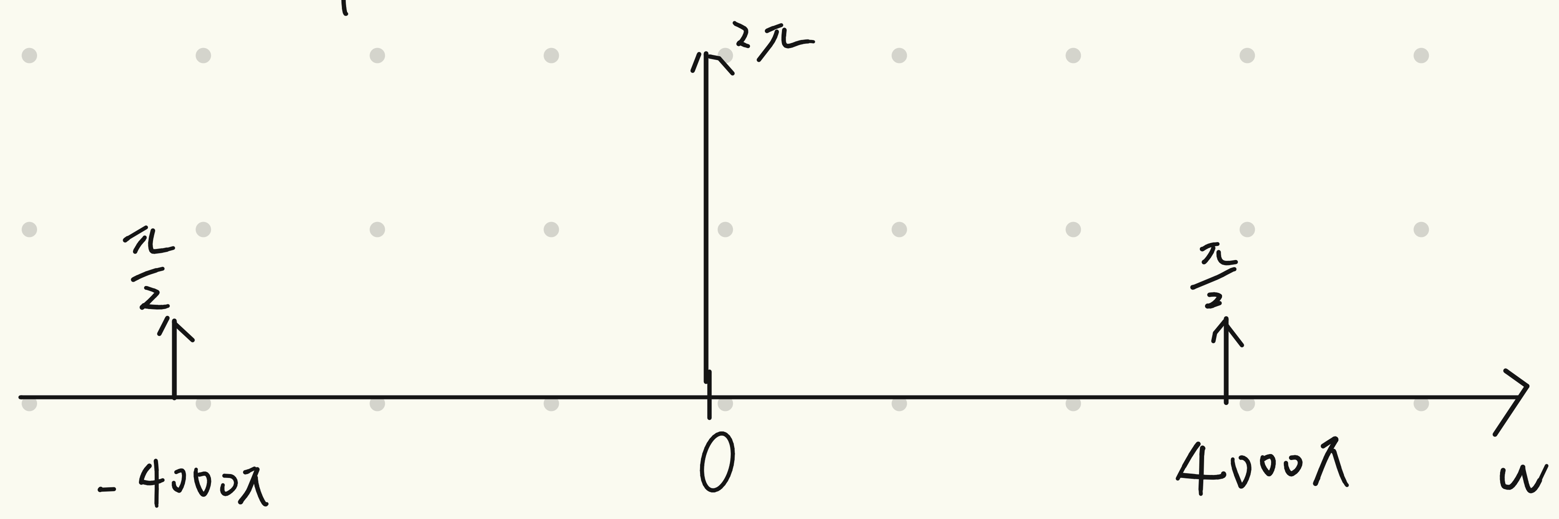
1.

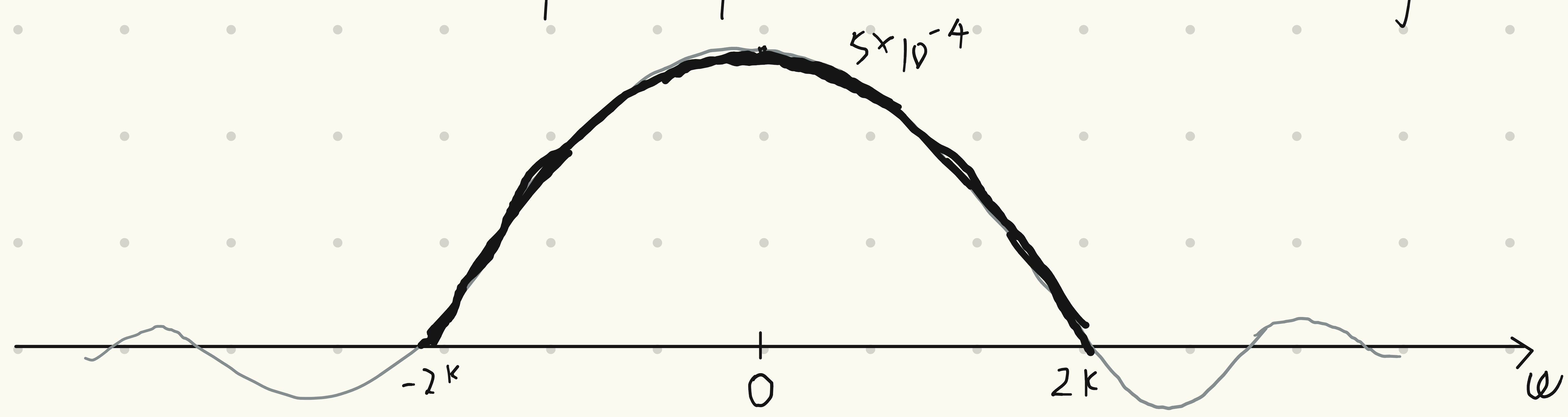
(a) $FT\{2\cos^2(2000\pi t)\} = FT\{\cos(4000\pi t)+1\} = \frac{\pi}{2}[\delta(\omega-4000\pi)+\delta(\omega+4000\pi)] + 2\pi\delta(\omega)$

so, the amplitude spectrum is as below



(b) $FT\{rect(\frac{t}{5\times10^{-4}})\} = 5\times10^{-4}\,sinc(5\times10^{-5}\omega)$

with a 4KH bandwidth, the amplitude spectrum is as below with black segment.



2

Time-domain.

$6\cos(200\pi t)+8\sin(200\pi t) = 10\sin(200\pi t) \qquad T = 10^{-2}$

$$P = \overline{s^2(t)} = 10^2\int_{-5\times10^{-3}}^{5\times10^{-3}} 100\sin^2(200\pi t)\,dt$$

$$= 10^4\int_{-5\times10^{-3}}^{5\times10^{-3}} \frac{1}{2} - \frac{\cos(400\pi t)}{2}\,dt$$

$$= 5\times10^3\left(1 - \frac{1}{400\pi}\sin(400\pi t)\right)\Big|_{-5\times10^{-3}}^{5\times10^{-3}}$$

$$= 50$$

Frequency domain:

$s(t) = 6\cos(200\pi t) + 8\cos(200\pi t + 100\pi^2)$

$S_s(t) = 25[\delta(f-100)+\delta(f+100)]$

$$\therefore \overline{s^2(t)} = 25\int_{-\infty}^{\infty}\delta(f-100)+\delta(f+100)\,df$$

$$= 50$$

#3

(a) $H(j\omega) = FT(\mathrm{sinc}(\frac{t}{50})) = 50\ \mathrm{rect}(\frac{j\omega}{50})$ $\quad BW = \frac{T}{2} = 25$

(b) $FT(\mathrm{sinc}\frac{t-4}{50})$ compare to $FT(\mathrm{sinc}(\frac{t}{50}))$, only a time-shifting coeffeient $e^{-j\omega\frac{4}{50}}$ was mutipul to $50\mathrm{rect}(\frac{j\omega}{50})$

so BW is still 25

(c) $\int_{-\infty}^{\infty} -4\cdot e^{-j\omega t}\,dt = -4\int_{-\infty}^{\infty} e^{-j\omega t}\,dt = -8\pi\delta(\omega)$

$L(j\omega) = FT(\sin(\frac{t}{50})-4) = 50\mathrm{rect}(\frac{j\omega}{50}) - 8\pi\delta(\omega)$

the spectrum gain a loss at origin:

but the BW is still 25

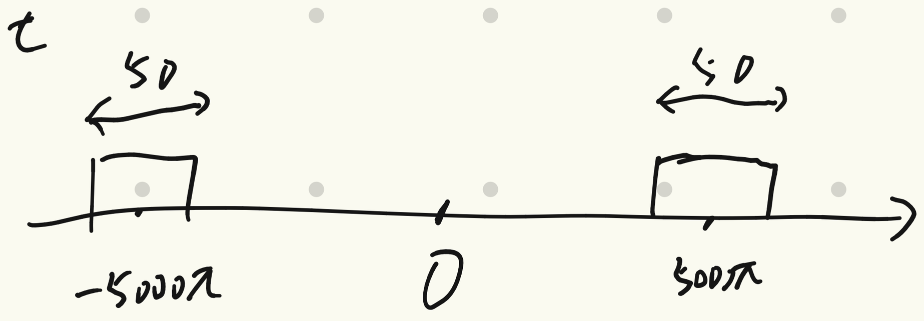
(d) $\sin(5000\pi t) = -\frac{j}{2}(e^{5000\pi t} - e^{-5000\pi t})$

$d(t) = \mathrm{sinc}(\frac{t}{50})\sin(5000\pi t) = -\frac{j}{2}e^{5000\pi t}\,\mathrm{sinc}(\frac{t}{50}) + \frac{j}{2}e^{-5000\pi t}\,\mathrm{sinc}(\frac{t}{50})$

$D(j\omega) = \frac{j}{2}[A(j(\omega-5000\pi)) - A(j(\omega+5000\pi))]$

So the $5000\pi > 50$.

so $D(j\omega)$ is a band-pass filter obtain by $\mathrm{sinc}(\frac{t}{50})$ time-shift



The BW is 50.