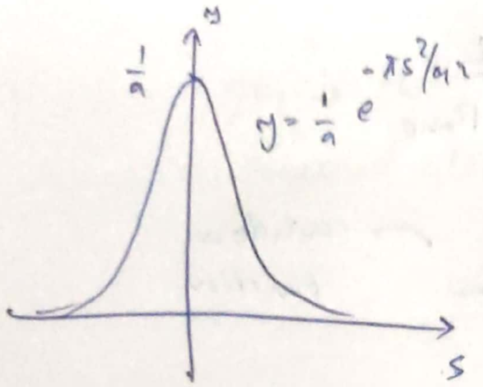
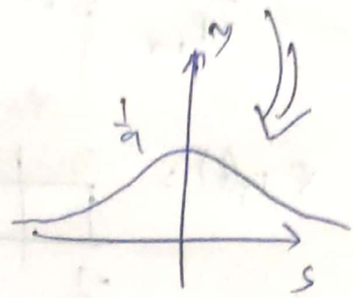
a.) $F(s) = \frac{1}{a} e^{-\pi s^2/a^2}$

as a increase graph becomes





as a increases

we get the graph compressed down in y axis

and stretchs along s axis

b) $a = 1$ (Sampling in time)

$T_s = R_{time}$

$f\{n R_{time}\}$

aproximate integral form is

$$F f(j\omega) = \sum_{n=-\infty}^{\infty} f\{n R_{Time}\} \cdot e^{-j\Omega n \cdot R_{Time}}$$

$$F(f(s)) = \sum_{n=-\infty}^{\infty} f[n R_{Time}] e^{-S n R_{Time}}$$

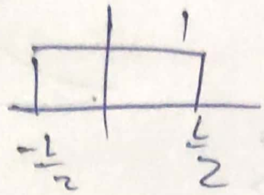
$$= \sum_{n=-\infty} e^{-(\pi n^2 R_{time}^2 + S n R_{time})}$$

Let for $n = 0$ we can see an infinite summation .

c) let $-\frac{L}{2} \le nR_{time} < \frac{L}{2}$

$$-\frac{L}{2R_{time}} \le n \le \frac{L}{2R_{time}}$$

& $w_1(t) =$



window function

$\therefore f(t) = e^{-a^2\pi t^2}$ $\quad -\infty < t < \infty$

$\therefore f_1(t) = f(t)\, w_1(t) = e^{-a^2\pi t^2} \times 1$ $\quad -\frac{L}{2} < t < \frac{L}{2}$

$$\therefore F\cdot f_1(s) = \sum_{n=-\frac{L}{2R_{fine}}}^{\frac{L}{2R_{fine}}} f(nR_{time})\, e^{-snR_{time}}$$

$\therefore$ finite summation $= \displaystyle\sum_{n=-\frac{L}{2R_{fine}}}^{\frac{L}{2R_{fine}}} e^{-(a^2\pi n^2 R_{fine}^2 + snR_{fine})}$

d) Sampling Freq domain

$$x[k] = \sum_n x[n]\, e^{-j\frac{2\pi kn}{N}} \quad 0 \le n < N$$

here $k = mR_{freq}$ & $k \in \left[-\frac{B}{2}, \frac{B}{2}\right]$

$$x(mR_{freq}) = \sum_{n=-\infty} f(nR_{time})\, e$$

d).

$$F\, f(m R_{freq}) = \sum_{n=-d}^{d} f(n R_{time})\, e^{-m R_{freq}\, n R_{time}}$$

$$= \sum_{n=-d}^{d} e^{-d\pi n^2 R_{time}^2 - m n R_{freq} R_{time}}$$

where $-\frac{B}{2R_{freq}} \le m < \frac{B}{2R_{freq}}$

This is the required approximate expression

e) No. of samples need to be stored in time domain.

$$\frac{L}{R_{time}}$$

No. of vals computed in freq domain is $\frac{B}{R_{freq}}$

g) changing the value of R_{freq} doesn't change the characteristics much as the the rate at which we view the sampled freq domain output varies

but altering the R_{time} & L changes the shapes of graph makes it steep h)

$$w_2(t) = \begin{cases} 1 - \frac{2|t|}{L} & \text{for } |t| \leq L/2 \\ 0 & \text{else} \end{cases}$$

$$w_3(t) = \begin{cases} \sin^2 \frac{2\pi t}{L} & \text{for } -\frac{L}{2} \leq t \leq \frac{L}{2} \\ 0 & \text{else} \end{cases}$$

plotting done in phython3

(i) for $g(t) = \cos 2\pi t + 0.5 \sin 4\pi t$

analysis is same as the above $e^{-a^2 \pi t^2}$

but writing $\cos 2\pi t$ as $\frac{e^{j2\pi t} + e^{-2\pi j t}}{2}$

& $\frac{1}{2} \sin 4\pi t$ as $\frac{1}{2}\left(\frac{e^{j4\pi a} - e^{-4\pi j t}}{2j}\right)$

and repeating

& plots are given in python