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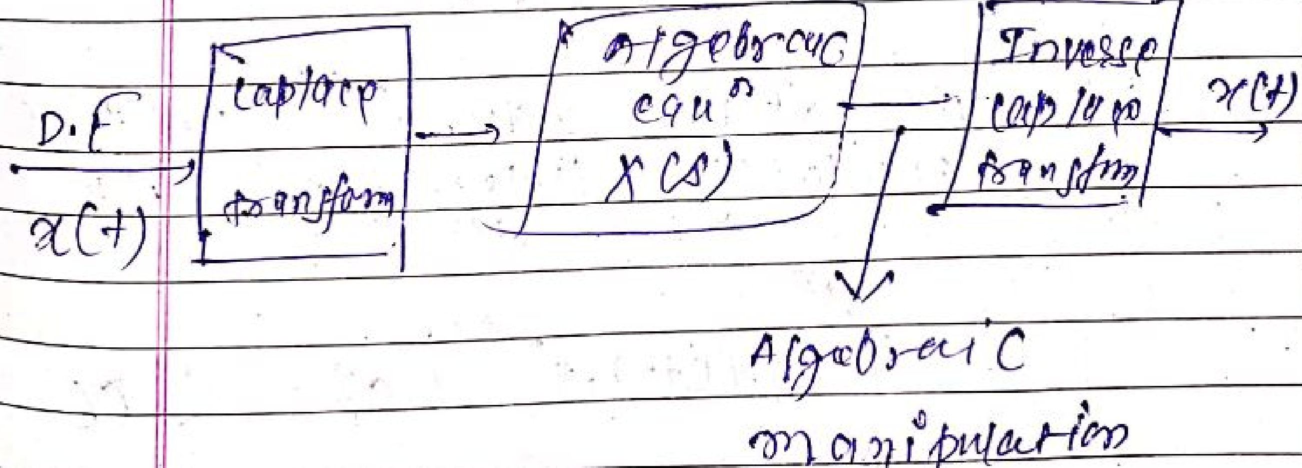
UNIT :- 4

1) Laplace transform and properties
2) Partial fraction
3) singularity fx^n
4) waveform synthesis
5) ~~Analysis of RC, RL, RLC circuit~~ with & without initial $cond^n$ using laplace transformation.

6) Evaluation of initial condition.

⇒ Laplace transform and properties (For Dis-conti)

1) ~~$Determin^n$ of CF~~
2) $Determin^n$ of P.I
3) $Determin^n$ of arbitrary const



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$$\mathcal{L}[x(t)] = \int_{-\infty}^{\infty} x(t).e^{-st}.dt = X(s)$$

Bilateral L.T
or
Two-sided L.T

where
s = complex number
$\boxed{s = \sigma + j\omega}$ *

$$x(t) = \int_{0}^{\infty} x(t).e^{-st}.dt \rightarrow \text{unilateral or one-sided LT}$$

Note:

⇒ Necessary and sufficient condition

1) $x(t)$ must be linear or piecewise linear in finite time interval

2) The term $x(t).e^{-\sigma t}$ must be absolutely integrable. i.e

$$\int_{-\infty}^{\infty} |x(t).e^{-\sigma t}|\, dt < \infty$$

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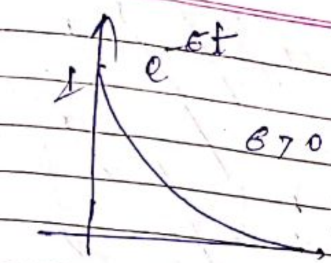


The reason for which Laplace transform converses is known as reason of convergence and it is decided by Range of 'σ'

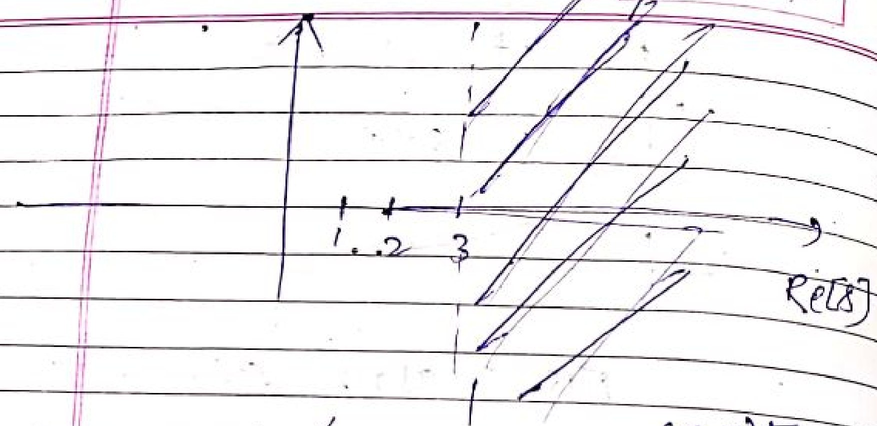
$x(t) = e^{3t}.u(t)$

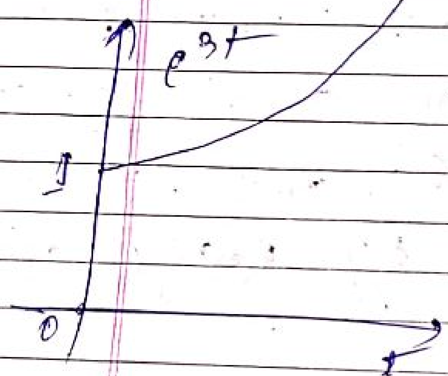
$$\mathcal{L}[e^{3t}.u(t)] = \int_{-\infty}^{\infty} e^{3t}.u(t).e^{-st}.dt$$

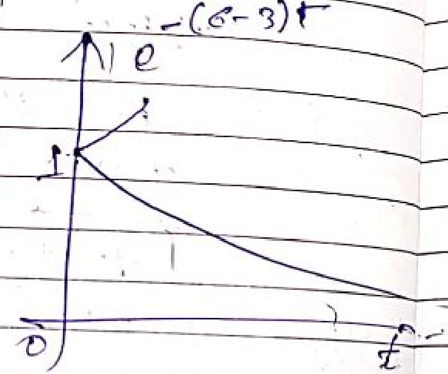
$$= \int_{0}^{\infty} e^{3t}.e^{-st}.dt = \underbrace{\int_{0}^{\infty} e^{-(s-3)t}\, dt}_{\text{will converge if } s-3>0}$$

$s-3>0$
$s>3$ $\quad$ $Re(s) > 3$

$s = (\sigma + j\omega)t$







Find the laplace transfrom of u(t)

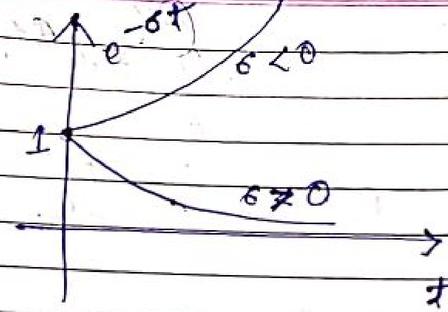
(1) $\mathcal{L}[u(t)] = \int_{-\infty}^{\infty} u(t) \cdot e^{-st}\, dt$

$= \int_{0}^{\infty} 1 \cdot e^{-st} \cdot dt = \frac{1}{s}$

$s > 0 \rightarrow$ converge

$s < 0 \rightarrow$ diverge

$Re(s) > 0$



Que (2) Find the laplace transfrom of $\delta(t)$ (unit impulse)

Ans

$\mathcal{L}[\delta(t)] = \int_{-\infty}^{\infty} \delta(t) \cdot e^{-st} \cdot dt$

$= e^{-st}\Big|_{t=0} = 1$

For any value of s.

Que (3) Ramp fn

$r(t) = t \cdot u(t)$

$= \begin{cases} t & t \geq 0 \\ 0 & t < 0 \end{cases}$

$\mathcal{L}[r(t)] = \int_{-\infty}^{\infty} t \cdot u(t) \cdot e^{-st} \cdot dt$

$\frac{1}{s}$ = integrator

$s \rightarrow$ differentiator

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$= \int_0^{\infty} t \cdot e^{-st} \cdot dt$

$R(s) = \frac{1}{s^2} = \frac{1}{s} \cdot \frac{1}{s} = \frac{1}{s}\left[U(s)\right]$

$\boxed{U(s) = s \cdot R(s)}$

(4) Exponential fxn e^{at} and e^{-at}

(5) complex expo fx^n $e^{-j\omega t}$, $e^{j\omega t}$

(6) sine & cosine fx^n

$\frac{\omega}{s^2+\omega^2}$ sin ω / cos ω $\frac{s}{s^2+\omega^2}$

(7) damped sinosoidal fx^n

$\frac{\omega}{(s+a)^2+\omega^2}$ $e^{-at}\sin\omega t$, $e^{-at}\cos\omega t$ $\frac{s+a}{\omega^2+(s+a)^2}$

(8) Hyperbolic sine & cosine fx^n

(9) parabolic

$t^2 = \frac{2}{s^3}$

$\cos\omega t = \frac{e^{j\omega t} + e^{-j\omega t}}{2}$

$\sin\omega t = \frac{e^{j\omega t} - e^{-j\omega t}}{2j}$

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Qu Find the response i(t) when ckt excited by unit step fx^n