UNIT - IV: Inverse Laplace Transforms

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Definition of Inverse Laplace Transform

The Inverse Laplace Transform retrieves the time-domain function from the s-domain:

$$f(t) = \mathcal{L}^{-1} [F(s)]$$

Common Inverse Laplace Transforms

- $L^{-1} \left(\frac{1}{s} \right) = 1$
- $L^{-1} \left(\frac{1}{s^2} \right) = t$
- $L^{-1} \left(\frac{s}{s^2 + a^2} \right) = \cos(at)$
- $L^{-1} \left(\frac{a}{s^2 + a^2} \right) = \sin(at)$

Convolution Theorem

The convolution theorem states:

$$L^{-1} [F(s) G(s)] = (f * g)(t) = \int_0^t f(\tau) g(t-\tau) d\tau$$

This is useful in solving differential equations.

Solutions of Linear Ordinary Differential Equations

Laplace transforms are useful for solving second-order linear ODEs:

- Convert the ODE into algebraic equation using Laplace transform.
- Solve for F(s).
- Apply inverse Laplace transform to obtain f(t).