

Laplace Transforms Cheat Sheet (Theory Only)

1. Laplace Transform & Its Applications

Converts a **time-domain function** into a **complex frequency-domain representation**.

Helps solve **differential equations, control system analysis, and signal processing problems**.

Commonly used in **engineering, physics, and applied mathematics**.

Laplace Transform of Elementary Functions

The Laplace transform can be applied to basic functions such as:

- **Constants**
 - **Polynomials**
 - **Exponential Functions**
 - **Trigonometric Functions**
 - **Unit Step & Delta Functions**
-

2. Laplace Transform of Periodic Functions

A **periodic function** repeats after a fixed interval.

The Laplace transform of a periodic function helps analyze signals in **circuit analysis, vibrations, and control systems**.

3. Basic Properties of Laplace Transforms

1. Linearity Property

The Laplace transform of a linear combination of functions is the same linear combination of their transforms.

2. Shifting Property

Time Shifting: A delay in the time domain corresponds to an exponential factor in the Laplace domain.

Frequency Shifting: Multiplying a function by an exponential term shifts its transform.

3. Scaling Property

Compressing a function in time expands its Laplace transform in frequency and vice versa.

4. Differentiation Property

The Laplace transform of a function's derivative helps in solving **differential equations**.

5. Integration Property

The Laplace transform of an integral of a function relates to its transform divided by the frequency variable.

6. Convolution Theorem

The Laplace transform of the **convolution of two functions** is the **product of their individual Laplace transforms**.

Used in **signal processing and system responses**.

4. Laplace Transform of Derivatives & Integrals

Laplace Transform of Derivatives

Converts **differential equations** into **algebraic equations**, making them easier to solve.
Helps in **control systems and circuit analysis**.

Laplace Transform of Integrals

Used in **integral equations and physics problems**.

5. Initial & Final Value Theorems

1. Initial Value Theorem

Determines the initial behavior of a function using its Laplace transform.
Used to analyze **starting conditions in mechanical and electrical systems**.

2. Final Value Theorem

Determines the steady-state behavior of a function as **time approaches infinity**.
Helps in **stability analysis of control systems**.

This **Laplace Transform Cheat Sheet** covers **Laplace transforms of elementary & periodic functions, basic properties, derivatives, integrals, and initial & final value theorems** without proofs. Let me know if you need further explanations!