**CHAPTER NO: 01**

**Basic Introduction of Laplace Transform**

* 1. ***Historical Background of Laplace Transform***

Pierre-Simon, marquis de Laplace, (born March 23, 1749, Beaumount-en-Auge, [Normandy](https://www.britannica.com/place/Normandy), France—died March 5, 1827, Paris), French mathematician, astronomer, and physicist who was best known for his investigations into the stability of the [solar system](https://www.britannica.com/science/solar-system).

Laplace successfully accounted for all the observed deviations of the [planets](https://www.britannica.com/science/planet) from their theoretical orbits by applying [Sir Isaac Newton](https://www.britannica.com/biography/Isaac-Newton)’s theory of [gravitation](https://www.britannica.com/science/gravity-physics) to the solar system, and he developed a [conceptual](https://www.merriam-webster.com/dictionary/conceptual) view of evolutionary change in the structure of the solar system. He also demonstrated the usefulness of [probability](https://www.britannica.com/science/probability-theory) for interpreting scientific data.

* 1. ***Definition of Laplace Transform***

The Laplace transform is a linear operator that transform a function (signal, image etc.) from time domain into s-domain.

The Laplace transform is a linear operator that switched a function f(t) to F(s).

Mathematically: The Laplace transform is an integral transformation of a function f (t) from the time domain into the complex frequency domain, giving F(s).

where s is the combination of real and imaginary part and known as complex frequency

* 1. ***Types of Laplace Transforms***

The Laplace transform is divided into two types one unilateral or one-sided Laplace transform and other is bilateral or two-sided Laplace transform.

* + 1. ***Unilateral Laplace Transform***

A single sided using single infinite Laplace integral is known as Unilateral Laplace Transform.

* + 1. ***Bilateral Laplace Transform***

A two sided using double infinite Laplace integral is known as Bilateral Laplace Transform.

**Example 1.1 Determine the Laplace Transform of the function f(t) = 1**

**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.1**

>> syms t

>> f(t) = t^0;

>> L = laplace(f(t))

L =

1/s

>> pretty(L)

1

-

s

**Example 1.2 Determine the Laplace Transform of the function f(t) = 2**

**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.2**

>> syms t

>> f(t) = 2\*t^0;

>> L = laplace(f(t))

L =

2/s

>> pretty(L)

2

-

s

**Example 1.3 Determine the Laplace Transform of the function f(t) = e-2t**

**Solution:**



**MATLAB Code**

**% Write a MATLAB code of Example 1.3**

>> syms t

>> f(t) = exp(-2\*t);

>> L = laplace(f(t))

L =

1/(s + 2)

>> pretty(L)

1

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s + 2

**Example 1.4 Determine the Laplace Transform of the function f(t) = e-3t**



**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.4**

>> syms t

>> f(t) = exp(-3\*t);

>> L = laplace(f(t))

L =

1/(s + 3)

>> pretty(L)

1

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s + 3

**Example 1.5 Determine the Laplace Transform of the function f(t) = e2t**

**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.5**

>> syms t

>> f(t) = exp(2\*t);

>> L = laplace(f(t))

L =

1/(s - 2)

>> pretty(L)

1

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s - 2

**Example 1.6 Determine the Laplace Transform of the function f(t) = e3t**



**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.6**

>> syms t

>> f(t) = exp(3\*t);

>> L = laplace(f(t))

L =

1/(s - 3)

>> pretty(L)

1

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s - 3

* 1. ***Laplace Transform of Trigonometric Functions***

***Euler’s Identity***

**Example 1.7 Determine the Laplace Transform of the function f(t) = sin3t**

**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.7**

>> syms t

>> f(t) = sin(3\*t);

>> L = laplace(f(t))

L =

3/(s^2 + 9)

**Example 1.8 Determine the Laplace Transform of the function f(t) = sin5t**

**Solution:**

**MATLAB Code**

**% Write a MATLAB code of Example 1.8**

>> syms t

>> f(t) = sin(5\*t);

>> L = laplace(f(t))

L =

5/(s^2 + 25)

* 1. ***Region of convergence for the Laplace transform.***