

Laplace-transform table for NFE2105/NFM2106
University of Huddersfield

Definition: If $y(t)$ is a function, then its **Laplace transform** (LT) corresponds to the function

$$Y(s) \equiv \mathcal{L}[y(t)] := \int_0^{\infty} e^{-st}y(t) dt.$$

Note that if we are given $Y(s)$ we can find $y(t)$ such that $\mathcal{L}[y(t)] = Y(s)$; in this case the function $y(t)$ is referred to as the **inverse Laplace transform** of $Y(s)$, and we formally write

$$y(t) = \mathcal{L}^{-1}[Y(s)].$$

Both the LT and the inverse LT can be found by using the table included below.

Item	Functions (t domain)	Laplace Transforms (s domain)	NOTES
1	y or $y(t)$	Y or $Y(s)$	
2	$\frac{dy}{dt}$	$sY(s) - y(0)$	
3	$\frac{d^2y}{dt^2}$	$s^2Y(s) - sy(0) - y'(0)$	
4	1	$\frac{1}{s}$	
5	t	$\frac{1}{s^2}$	
6	t^n	$\frac{n!}{s^{n+1}}$	
7	$\frac{t^{n-1}}{(n-1)!}$	$\frac{1}{s^n}$	
8	e^{-kt}	$\frac{1}{s+k}$	
9	te^{-kt}	$\frac{1}{(s+k)^2}$	5 & 1st shift theorem
10	$\sin(at)$	$\frac{a}{s^2+a^2}$	
11	$\cos(at)$	$\frac{s}{s^2+a^2}$	
12	$e^{-kt} \sin(at)$	$\frac{a}{(s+k)^2+a^2}$	10 & 1st shift theorem
13	$e^{-kt} \cos(at)$	$\frac{s+k}{(s+k)^2+a^2}$	11 & 1st shift theorem

Table 1: TABLE OF LAPLACE TRANSFORMS (c.coman@hud.ac.uk)