THEOREMS[1-5]

References:

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For application of **Final value theorem,**
check whether the function final value available

$$t \to \infty$$

To find the value of function x(t) at time, t $\to \infty$
in terms of the final value theorem
and Laplace Transform x(s)

$$x(s)=\frac{s^3+3s^2+3s+1}{s^6+5s^5+10s^4+10s^3+5s^2+s}$$

By applying **final value theorem**

$$\lim_{s\to 0} sx(s)=\lim_{s\to 0}\frac{(s+1)^3}{(s+1)^5}=1$$

The case :

Final Value of the following function is not exist

$$x(s) = \frac{3s+1}{(s-8)(s+1)}$$

The roots:

s=8, s=-1

$t \rightarrow \infty$ $x(t) \rightarrow \infty$

In this case, the denominator of the function x(s) have positive roots **"Final Value Theorem "** is not valid.

Initial Value Theorem

$$x(s)=\frac{s^3+3s^2+3s+1}{s^6+5s^5+10s^4+10s^3+5s^2+s}$$

$$lim_{s\to\infty} sx(s)=lim_{s\to\infty}\frac{(s+1)^3}{(s+1)^5}=0$$

$$x(s)=\frac{1}{s(s^4+4s^3+6s^2+4s+1)} \qquad x(t)\big|_{t\to 0}=?$$

$$\lim_{t\to 0} x(t)=\lim_{s\to\infty}[s*x(s)]$$

$$\lim_{t\to 0} x(t)=\lim_{s\to\infty}\left[\frac{s}{s(s^4+4s^3+6s^2+4s+1)}\right]=\lim_{s\to\infty}\left[\frac{s}{s(s+1)^4}\right]=\lim_{s\to\infty}\left[\frac{1}{(s+1)^4}\right]=0$$

u(t) is the unit step function , u(t)=1.

(1):the value of the first step effect is (1/h)*u(t).

(2):the value of the second step effect is –(1/h)*u(t-h).

The laplace transform of a pulse effect: L{(1)+(2)}

$$\frac{Y(s)}{X(s)} = \frac{1}{5.2s + 1}$$

$$X(t) = 0.7[u(t) - u(t - 10)]$$

$$X(s) = \frac{0.7}{s} - \frac{0.7}{s}e^{-10s} = \frac{0.7}{s}(1 - e^{-10s})$$

$$Y(s) = X(s)\left(\frac{1}{5.2s + 1}\right)$$

$$Y(s) = \frac{0.7}{s}(1 - e^{-10s})\left(\frac{1}{5.2s + 1}\right)$$

$$Y(s) = 0.7\left(\frac{1}{s(5.2s + 1)} - \frac{e^{-10s}}{s(5.2s + 1)}\right)$$