# Topics



# Math review

## Partial fraction expansion (PFE)

Important for inverse Laplace and z-transforms. PFE allows you to split up a ratio of polynomials into a sum of fractions, with each denominator containing a single or repeated root.

Consider Nth and Mth-order polynomials

For , is a proper rational function. If you assume has no repeated roots, then the PFE of is

If you don’t assume no repeated roots, and each of roots has multiplicity such that , then

When (improper rational function), you need to use long division to reduce the numerator order to be less than the denominator order. You need to first put your ratio of polynomials in the form

Where is a proper rational function.

For distinct (no repeats) roots, the coefficients are given by

For repeated roots, the coefficients are given by

## Trigonometry

Useful trig identities:

## Complex arithmetic

Rectangular form (x-y coordinates):

Polar form (magnitude/envelope and phase):

Rectangular to polar conversion:

Polar to rectangular conversion:

Let .

Euler’s identity:

Example:

### Phasor analysis

Phasor analysis: when sinusoidal signals of the same frequency are added together (superimposed), the result is a single sinusoidal signal having a composite amplitude and phase. Mathematically,

The composite amplitude and phase are given by the vector addition of the individual amplitudes and phases.

Proof:

## Calculus and geometric series

Formally, has derivative at if this limit exists:

Differentiation formulas ( is constant and and are functions of ):

* (chain rule)

Indefinite integrals are also known as antiderivatives, i.e. if

Then

Useful indefinite integrals:

Useful definite integrals:

When a closed-form solution for integration is not available, use numerical integration (e.g. SciPy integrate module, quad function).

To find the minimum or maximum of a function , find

(As long as there is only one global minimum or maximum).

* If minimum,
* If maximum,

Finite and infinite geometric series are often found in discrete-time signals and systems.

Finite series: