Summarize the most important points from memory.

In the frequency domain, each frequency component is defined by frequency, amplitude, and phase. When analyzing signals all at the same frequency, you can use phasor analysis, which is vector arithmetic using amplitude and phase. That is, signals are represented as vectors, and you can add/subtract them accordingly.

PSD vs. ESD – notice that Fourier series is averaged over the period. Fourier transform is not because it is energy.

Every integration/summation over one period is averaged

Adding powers, orthogonality in freq domain

Integrating powers/energy – Parseval’s or Plancherel’s theorem

Continuous time

Fourier series

Fourier transform

Laplace transform

Typically, we use unilateral LT, not bilateral, so we analyze causal signals and systems.

For causal signals and systems, the ROC is of the form , where is the most positive pole. For FT to (formally) exist, the ROC must contain the axis, which means that all poles must be in the LHP. This is the same condition as being absolutely integrable (aka being in L1 space). For a system, this also means the system is BIBO stable.

Periodic power signals, PSD

Energy signals, ESD

FT in the limit

Is LTI system required for all of these properties?

Can all LTI systems be described by LCCDE?

LTI systems not described by LCCDE

Poles and zeros and frequency response

Real signal/system = only real poles or complex conjugate poles

For real coefficients, poles and zeros are either real or occur in complex conjugate pairs.

Residues for complex conjugate poles must be complex conjugates.

LCC differential equations

With initial conditions

Sampling

Discrete time

Fourier transform

Discrete Fourier series

Discrete Fourier transform

Remember, the “underlying” signal is periodic with period , so that’s why it’s circular time shift, frequency shift, and convolution.

You can implement freq domain filtering. Make sure circular convolution is equal to linear convolution. FFT/IFFT.