

# The Ten Essential Skills

You should strive for personal mastery over the following skills. These are the skills that other courses at MIT will expect you to have when you finish 18.03. This list of skills is widely disseminated among the faculty teaching courses listing 18.03 as a prerequisite. You must become proficient at them to prepare yourself for those courses.

1. Model a simple system to obtain a first order ODE.
2. Solve a first order linear ODE by the method of integrating factors or variation of parameter.
3. Calculate with complex numbers and exponentials.
4. Solve a constant coefficient second order linear initial value problem with driving term exponential times polynomial. In case of exponential (or sinusoidal) signal, compute amplitude gain and phase shift.
5. Utilize Delta functions in a signal, compute the unit impulse response, and express the system response to a general signal by means of the convolution integral.
6. Compute Fourier coefficients, and find periodic solutions of linear ODEs by means of Fourier series.
7. Use Laplace transform to describe growth/decay and oscillation of functions of time, for large time, and (using tables and partial fractions) to find the weight function and solve constant coefficient linear initial value problems.
8. Calculate eigenvalues, eigenvectors, and matrix exponentials, and use them to solve homogeneous first order linear systems; relate linear systems with higher-order ODEs.
9. Recreate the phase portrait of a two-dimensional linear autonomous system from trace and determinant.
10. Determine the qualitative behavior of an autonomous nonlinear two-dimensional system by means of nullclines and an analysis of behavior near critical points.