

The Ten Essential 18.03 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. Visualize solutions using direction fields and isoclines, and using the phase line for autonomous equations. Approximate solutions using Euler's method.
2. Solve a first order linear ODE by the method of variation of parameters or integrating factors.
3. Calculate with complex numbers and exponentials.
4. Solve a constant coefficient linear initial value problem with driving term exponential times polynomial. Employ superposition and time-invariance to relate solutions for different driving terms.
5. Compute amplitude gain and phase lag in case the input is sinusoidal. Determine damping characteristics in the second order case.
6. Compute Fourier coefficients, and find periodic solutions of linear ODEs by means of Fourier series.
7. Utilize the Heaviside step function and the Dirac delta function to model abrupt phenomena; compute the unit step and impulse response; and express the system response to a general signal by means of the convolution integral.
8. Use Laplace transform to find system responses (especially the unit impulse response) for linear time-invariant systems, and deduce stability properties from the pole diagram of the transfer function.
9. Calculate eigenvalues, eigenvectors, and matrix exponentials. Use linear algebra to solve first order homogeneous linear systems of differential equations. Sketch phase portraits in one and two dimensions.
10. Construct a first order system from a higher order ODE, and interpret the phase plane in the second order case. Determine the qualitative behavior of an autonomous nonlinear two-dimensional system by means of an analysis of behavior near critical points.