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 dissminated 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 approximate them using Euler's method.

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. If the input signal is sinusoidal, compute amplitude gain and phase shift.

5. Compute Fourier coefficients, and find periodic solutions of linear ODEs by means of Fourier series.

6. Utilize Delta functions to model abrupt phenomena, compute the unit impulse response, and express the system response to a general signal by means of the convolution integral.

7. Find the weight function or unit impulse response and solve constant coefficient linear initial value problems using the Laplace transform together with tables of standard values. Relate the pole diagram of the Laplace transform to the long-term behavior of a function.

8. Calculate eigenvalues, eigenvectors, and matrix exponentials, and use them to solve first order linear systems. Relate first order 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 an analysis of behavior near critical points.

18.03 Differential Equations
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