

As a bare minimum, for the midterm exam you should:¹

- 1) understand basic language of differential equations (DE, IC, IVP, order, implicit / explicit / general / particular solution, etc.);
- 2) be able to distinguish a linear equation;
- 3) understand concepts of direction field, phase portrait, autonomous equation, terminal value of the unknown function, be able to sketch solution to an IVP on the direction field;
- 4) solve first order separable DE and IVP;
- 5) solve first order linear DE and IVP;
- 6) be able to recognise and solve exact (and almost exact) DEs;
- 7) be able to write down first or second order DE IVP which models certain process (gravitation, cooling/warming, population dynamics, etc.) *and* be able to solve first order DE IVPs;
- 8) understand Euler's method and be able to compute $n \leq 4$ steps to estimate the solution to an IVP;
- 9) use Wronskian to determine whether a set of functions is linearly independent in an interval;
- 10) use reduction of order to find the general solution to linear second order DE given a solution;
- 11) solve homogeneous linear DE with constant coefficients; in particular, understand what a fundamental set is, be able to check whether a set of functions is linearly independent;
- 12) solve non-homogeneous linear DE with c.c. using method of undetermined coefficients;
- 13) solve non-homogeneous linear DE with c.c. using variation of parameters;

¹As of 25th February 2026. This list will be expanding as we cover new topics.