

Final Exam Review

Focus your study on the previous two exams, the quizzes, and the homework. Exam problems will be *similar (though not identical) in all cases* to problems you've seen. Some things to keep in mind as you study:

1. The most important action you can take to be successful on the exam is to **work lots of problems without the aid of written solutions**. This will point out your weaknesses and get you used to exam-like conditions.
2. Don't try to memorize the step-by-step process for solving particular problems, rather learn the basic methods and work hard on developing your calculus and algebra fundamentals (which doesn't happen when you follow the solutions closely).
3. You will need to know some or all of the following basic derivative formulas:

$$\begin{aligned}\frac{d}{dx} [e^{u(x)}] &= \frac{d}{dx} [u(x)] e^{u(x)}, \\ \frac{d}{dx} [\ln(u(x))] &= \frac{1}{u(x)} \frac{d}{dx} [u(x)], \\ \frac{d}{dx} [u(x)^a] &= a u(x)^{a-1} \frac{d}{dx} [u(x)], \\ \frac{d}{dx} [u(x)v(x)] &= \frac{d}{dx} [u(x)]v(x) + u(x) \frac{d}{dx} [v(x)], \\ \frac{d}{dx} \left[\frac{u(x)}{v(x)} \right] &= \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2} (x)\end{aligned}$$

4. You will need to be able to compute integrals of the following form (note that x here can be replaced by some other variable like y, z , etc.):

$$\int \frac{c dx}{x}, \quad \int \frac{c dx}{ax+b}, \quad \int c x^r dx, \quad \int c(ax+b)^r dx, \quad \int c e^{ax+b} dx, \quad \int c x e^{ax^2+b} dx,$$

where a, b, c, r any numbers with $a \neq 0$ and $r \neq -1$.

5. You will be given the following integral formulas if the corresponding integrals come up:

$$\begin{aligned}\int x e^{ax} dx &= \frac{e^{ax}}{a} \left(x - \frac{1}{a} \right) + C, \quad a \neq 0, \\ \int e^{ax} \sin bx dx &= \frac{e^{ax}}{a^2 + b^2} (a \sin bx - b \cos bx) + C, \quad a, b \neq 0, \\ \int e^{ax} \cos bx dx &= \frac{e^{ax}}{a^2 + b^2} (a \cos bx + b \sin bx) + C, \quad a, b \neq 0.\end{aligned}$$

Recall that the last two integral formulas were needed in the electrical circuit problems, and the first one was needed in the *integration factor method* homework.

6. Main Topics:

- (a) direction fields (exam 1 material);
- (b) *Euler's method* for both ODEs and systems of ODEs (exam 1 material and quiz 11);
- (c) the *method of separation of variables* (exam 1 material, integrals restricted to those above);
- (d) show that a function (or functions in the case of systems) is a solution of an ODE (or system of ODEs) (exam 1, 2, and recent material);
- (e) the *method of integration factors* (exam 1 material, integrals restricted to those above);
- (f) the solution of second order, constant coefficient differential equations, homogeneous and non-homogeneous (exam 2 material);
- (g) the solution of systems of two, linear constant coefficient differential equations using the *method of elimination* and the *method of determinants* (recent material)
- (h) predator-prey differential equation: finding equilibrium points and determining which is predator and which is prey;
- (i) applications: differential equation models will be posed for you; the only one you might see needing a bit different treatment is the nonhomogeneous electrical circuit problems from Section 7.5 (e.g. see problem 1).

7. You may use your equation cards from Exams 1 and 2 and have another for this exam.