Math 310: Ordinary Differential Equations

Here is a list that you must know (commit to memory). Tests are closed books!

Product rule, quotient rule and chain rule for differentiation.

$$\frac{d}{dx}\,\mathrm{e}^{ax} = a\,\mathrm{e}^{ax} \qquad \int \mathrm{e}^{ax}\,dx = \frac{1}{a}\,\mathrm{e}^{ax} + C$$

$$\frac{d}{dx}\ln x = \frac{1}{x} \qquad \int \frac{dx}{x}dx = \ln|x| + C$$

$$\frac{d}{dx}\sin x = \cos x \qquad \int \cos x dx = \sin x + C$$

$$\frac{d}{dx}\cos x = -\sin x \qquad \int \sin x dx = -\cos x + C$$

$$\frac{d}{dx}\tan x = \sec^2 x \qquad \int \sec^2 x dx = \tan x + C$$

$$\frac{d}{dx}\cot x = -\csc^2 x \qquad \int \csc^2 x dx = -\cot x + C$$

$$\frac{d}{dx}\sec x = \sec x \tan x \qquad \int \sec x \tan x dx = \sec x + C$$

$$\frac{d}{dx}\csc x = -\csc x \cot x \qquad \int \csc x \cot x dx = -\csc x + C$$

Def $\sinh x = \dfrac{\mathrm{e}^x - \mathrm{e}^{-x}}{2}$ $\qquad \cosh x = \dfrac{\mathrm{e}^x + \mathrm{e}^{-x}}{2}$

$$\frac{d}{dx}\sinh x = \cosh x \qquad \frac{d}{dx}\cosh x = \sinh x$$

$$\frac{d}{dx}\arcsin x = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}\arccos x = \frac{-1}{\sqrt{1-x^2}}$$

$$\int \frac{dx}{\sqrt{1-x^2}} = \begin{array}{l}\arcsin x + C_1 \\ \arccos x + C_2\end{array}\Bigg\} \qquad \frac{d}{dx}\arctan x = \frac{1}{1+x^2} \qquad \int \frac{1}{1+x^2}dx = \arctan x + C$$

$$\sin(a \pm b) = \sin a \cos b \pm \cos a \sin b \qquad \cos(a \pm b) = \cos a \cos b \mp \sin a \sin b$$

$$\sin(2x) = 2\sin x \cos x \qquad \cos(2x) = \cos^2 x - \sin^2 x$$

$$\sin^2 x + \cos^2 x = 1 \qquad 1 + \cot^2 x = \csc^2 x \qquad \tan^2 x + 1 = \sec^2 x$$

You must know the graphs of polynomials, trigonometric functions, inverse trigonometric functions, e^{ax}, $\ln x$, $\sinh x$, $\cosh x$.

Also, partial fraction decomposition and integration by parts:

$$\int u\,dv = uv - \int v\,du \quad \text{or} \quad \int u\frac{dv}{dx}\,dx = uv - \int v\frac{du}{dx}\,dx$$