MAT 170 Section 005 Fall 2005

Some things (not everything) to remember from Chapter 3

1. Product rule: $\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}[g(x)] + g(x)\frac{d}{dx}[f(x)]$.

2. Quotient rule: $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)\frac{d}{dx}[f(x)] - f(x)\frac{d}{dx}[g(x)]}{(g(x))^2}$.

3. Chain rule: If $F(x) = f(g(x))$, then $F'(x) = f'(g(x))g'(x)$.

4. $\lim_{\theta\to 0}\frac{\cos(\theta)-1}{\theta} = 0$, $\lim_{\theta\to 0}\frac{\sin(\theta)}{\theta} = 1$.

5. Hyperbolic functions:

$$\begin{aligned}
\cosh(x) &= \frac{e^x + e^{-x}}{2} \\
\sinh(x) &= \frac{e^x - e^{-x}}{2} \\
\tanh(x) &= \frac{e^x - e^{-x}}{e^x + e^{-x}} \\
\coth(x) &= \frac{e^x + e^{-x}}{e^x - e^{-x}} \\
\operatorname{sech}(x) &= \frac{2}{e^x + e^{-x}} \\
\operatorname{csch}(x) &= \frac{2}{e^x - e^{-x}}
\end{aligned}$$

6. Properties of trigonometric and hyperbolic functions:

$$\begin{aligned}
\cos^2(x) + \sin^2(x) &= 1 \\
\cosh^2(x) - \sinh^2(x) &= 1
\end{aligned}$$

7. Derivatives

Polynomials

$$\frac{d}{dx}[x^n] = nx^{n-1}$$

Exponentials

$$\frac{d}{dx}[e^x] = e^x$$

$$\frac{d}{dx}[a^x] = a^x \ln(a)$$

Logarithims

$$\frac{d}{dx}[\ln(x)] = \frac{1}{x}$$

$$\frac{d}{dx}[\log_a(x)] = \frac{1}{x\ln(a)}$$

Trigonometric

$$\frac{d}{dx}[\cos(x)] = -\sin(x)$$

$$\frac{d}{dx}[\sin(x)] = \cos(x)$$

$$\frac{d}{dx}[\tan(x)] = \sec^2(x)$$

$$\frac{d}{dx}[\cot(x)] = -\csc^2(x)$$

$$\frac{d}{dx}[\sec(x)] = \sec(x)\tan(x)$$

$$\frac{d}{dx}[\csc(x)] = -\csc(x)\cot(x)$$

Inverse Trigonometric

$$\frac{d}{dx}\left[\cos^{-1}(x)\right] = -\frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left[\sin^{-1}(x)\right] = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left[\tan^{-1}(x)\right] = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\left[\cot^{-1}(x)\right] = -\frac{1}{1+x^2}$$

$$\frac{d}{dx}\left[\sec^{-1}(x)\right] = \frac{1}{x\sqrt{x^2-1}}$$

$$\frac{d}{dx}\left[\csc^{-1}(x)\right] = -\frac{1}{x\sqrt{x^2-1}}$$

Hyperbolic

$$\frac{d}{dx}[\cosh(x)] = \sinh(x)$$

$$\frac{d}{dx}[\sinh(x)] = \cosh(x)$$

$$\frac{d}{dx}[\tanh(x)] = \operatorname{sech}^2(x)$$

$$\frac{d}{dx}[\coth(x)] = -\operatorname{csch}^2(x)$$

$$\frac{d}{dx}[\operatorname{sech}(x)] = -\operatorname{sech}(x)\tanh(x)$$

$$\frac{d}{dx}[\operatorname{csch}(x)] = -\operatorname{csch}(x)\coth(x)$$

Inverse Hyperbolic

$$\frac{d}{dx}\left[\cosh^{-1}(x)\right] = \frac{1}{\sqrt{x^2-1}}$$

$$\frac{d}{dx}\left[\sinh^{-1}(x)\right] = \frac{1}{\sqrt{1+x^2}}$$

$$\frac{d}{dx}\left[\tanh^{-1}(x)\right] = \frac{1}{1-x^2}$$

$$\frac{d}{dx}\left[\coth^{-1}(x)\right] = \frac{1}{1-x^2}$$

$$\frac{d}{dx}\left[\operatorname{sech}^{-1}(x)\right] = -\frac{1}{x\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left[\operatorname{csch}^{-1}(x)\right] = -\frac{1}{|x|\sqrt{x^2+1}}$$