Math 2150-01

8/20/25

Topic 0- Calculus Review

$$\frac{d}{dx} x^n = n x^{n-1}$$ ← $(x^3)' = 3x^2$

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

$$\frac{d}{dx}\ln(x) = \frac{1}{x} \qquad \frac{d}{dx} e^x = e^x$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C$$ ← $\int x^8 dx = \frac{x^9}{9} + C$

$n \neq -1$

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

$$\int \sin(x) dx = -\cos(x) + C$$

$$\int \cos(x) dx = \sin(x) + C$$

$$\int e^x dx = e^x + C$$

Chain rule:

$$(f(g(x)))' = f'(g(x)) \cdot g'(x)$$

Ex: $\frac{d}{dx} e^{5x^3} = (e^{5x^3}) \cdot 15x^2$

$= 15x^2 e^{5x^3}$

Ex:

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

$= -\sin(x)\cos(\cos(x))$

Product rule

$$(fg)' = f'g + fg'$$

Ex:

$$\frac{d}{dx}\left(x^3\tan(x)\right) = 3x^2\tan(x) + x^3\sec^2(x)$$

Substitution

$$\int f(g(x))\cdot g'(x)\,dx = \int f(u)\,du$$

$u = g(x)$

$du = g'(x)\,dx$

Ex: $\int 5e^{5x}\,dx = \int e^u\,du$

$u = 5x$

$du = 5\,dx$

$$= e^u + C = e^{5x} + C$$

Ex: $\int \cos(10x)\,dx = \frac{1}{10}\sin(10x) + C$

$\int \cos(10x)\,dx = \int \frac{1}{10}\cos(u)\,du$

$u = 10x$

$du = 10\,dx$

$\frac{1}{10}\,du = dx$

$= \frac{1}{10}\sin(u) + C$

$= \frac{1}{10}\sin(10x) + C$

Ex: $\int \frac{1}{x(\ln(x))^2}\,dx = \int \frac{1}{x}\frac{1}{(\ln(x))^2}\,dx$

$= \int \frac{1}{u^2}\,du = \int u^{-2}\,du = \frac{u^{-2+1}}{-2+1} + C$

$= -u^{-1} + C$

$u = \ln(x)$

$du = \frac{1}{x}\,dx$

$$= -\frac{1}{u} + C = -\frac{1}{\ln(x)} + C$$

Integration by parts

$$\int u\,dv = uv - \int v\,du$$

picking u :

L I A T E ← exponential

trigonometric

logarithmic

inverse trig

algebraic

order to pick u

Ex:

$$\int \underbrace{x}_{u}\,\underbrace{e^{x}\,dx}_{dv}$$

exponential

algebraic

$$= \underbrace{x e^x}_{uv} - \underbrace{\int e^x \, dx}_{\int v \, du}$$

$u = x$ $\quad du = dx$

$dv = e^x dx$ $\quad v = e^x$

$$= x e^x - e^x + C$$