Important Formulae List

Integration

Rules of Integration

1. $\int cf(x)dx = c \int f(x)\, dx$
2. $\int \big(f(x) + g(x)\big)dx = \int f(x)dx + \int g(x)dx$

Integration of Algebraic Functions

1. $\int u^n \frac{du}{dx} dx = \frac{u^{n+1}}{n+1} + C$
2. $\int \frac{1}{u}\frac{du}{dx} dx = \ln|u| + C$

Integration of Trigonometric Functions

1. $\int \cos u \frac{du}{dx} dx = \sin u + C$
2. $\int \sin u \frac{du}{dx} dx = -\cos u + C$
3. $\int \tan u \frac{du}{dx} dx = \ln|\sec u| + C$
4. $\int \text{cosec}\, u \frac{du}{dx} dx = \ln(cosec\, u - \cot u) + C$
5. $\int \sec u \frac{du}{dx} dx = \ln(\sec u + \tan u) + C$
6. $\int \cot u \frac{du}{dx} dx = \ln|\sin u| + C$
7. $\int sec^2 u \frac{du}{dx} dx = \tan u + C$
8. $\int \sec u \tan u \frac{du}{dx} dx = \sec u + C$
9. $\int cosec u\, cot u \frac{du}{dx} dx = -cosec\, u + C$
10. $\int cosec^2 u \frac{du}{dx} dx = -\cot u + C$

Integration of Exponential Functions

1. $\int e^u \frac{du}{dx} dx = e^u + C$
2. $\int a^x dx = \frac{a^x}{\ln a} + C$

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Integration of Functions yielding Inverse Trigonometric Functions

1. $\int \frac{1}{\sqrt{a^2-u^2}} \frac{du}{dx} dx = \sin^{-1} \frac{u}{a} + C$
2. $\int \frac{1}{\sqrt{a^2-u^2}} \frac{du}{dx} dx = -\cos^{-1} \frac{u}{a} + C$
3. $\int \frac{1}{a^2+u^2} \frac{du}{dx} dx = \frac{1}{a} \tan^{-1} \frac{u}{a} + C$
4. $\int \frac{1}{|u|\sqrt{u^2-a^2}} \frac{du}{dx} dx = \frac{1}{a} \sec^{-1} \frac{u}{a} + C$

Integration of Function yielding Logarithmic Function

1. $\int \frac{1}{u} \frac{du}{dx} dx = \ln u + C$

Integration of Miscellaneous Functions

1. $\int \frac{1}{u^2-a^2} \frac{du}{dx} dx = \frac{1}{2a} \ln \frac{u-a}{u+a} + C$
2. $\int \frac{1}{a^2-u^2} \frac{du}{dx} dx = \frac{1}{2a} \ln \frac{a+u}{a-u} + C$
3. $\int \frac{1}{\sqrt{u^2+a^2}} \frac{du}{dx} dx = \ln\left(u + \sqrt{u^2 + a^2}\right) + C$
4. $\int \frac{1}{\sqrt{u^2-a^2}} \frac{du}{dx} dx = \ln\left(u + \sqrt{u^2 - a^2}\right) + C$
5. $\int \sqrt{a^2 - u^2} \frac{du}{dx} dx = \frac{1}{2} u\sqrt{a^2 - u^2} + \frac{1}{2} a^2 \sin^{-1} \frac{u}{a} + C$
6. $\int \sqrt{a^2 + u^2} \frac{du}{dx} dx = \frac{1}{2} u\sqrt{a^2 - u^2} + \frac{1}{2} a^2 \ln\left(u + \sqrt{u^2 + a^2}\right) + C$
7. $\int \sqrt{u^2 - a^2} \frac{du}{dx} dx = \frac{1}{2} u\sqrt{u^2 - a^2} - \frac{1}{2} a^2 \ln\left(u + \sqrt{u^2 - a^2}\right) + C$

Where u is a function of x

Integration By Trigonometric Substitution

1. For **integrand** of the form $\sqrt{a^2 - x^2}$, **substitute** $x = a \sin \theta$
2. For **integrand** of the form $\sqrt{a^2 + x^2}$, **substitute** $x = a \tan \theta$
3. For **integrand** of the form $\sqrt{x^2 - a^2}$, **substitute** $x = a \sec \theta$

Integration By Parts

$\int uv \, dx = u \int v \, dx - \int \left(\frac{du}{dx} \int v \, dx \right) dx$

Note: Techniques of Integration will be discussed in class.

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