

EOSC 250 - Geophysical Fields and Fluxes

Mathematical background homework

due Wednesday, January 15th, 2024.

Compute df/dx for the following functions (where a , b , k and n are constants):

1. $f(x) = (ax + b)^n$

2. $f(x) = x^n \cos(x)$

3. $f(x) = \sin(x) \cos(x)$

4. $f(x) = \exp\left(-\frac{(ax+b)^2}{2}\right)$

5. $f(x) = x^2 \log(x) - x^2/2$

6. $f(x) = x \exp(kx)$

7. $f(x) = [\exp(kx)]^n$

Note: \log here (and anywhere in this course) is \log with base $e = 2.71\dots$

Compute the following indefinite integrals (where a , b , k and n are constants):

1. $\int x(ax + b)^n dx$

2. $\int x \sin(x) dx$

3. $\int \cos(ax + b) dx$

4. $\int \frac{1}{a+x} dx$

5. $\int \cos^n(x) \sin(x) dx$

6. $\int x \cos(x) + \sin(x) dx$

7. $\int x \exp(-x^2) dx$

8. $\int -\log[\cos(x)] \times \sin(x) dx$

Compute the following definite integrals (where a , b , n and k are constants):

1. $\int_0^1 \exp(x) dx$

2. $\int_0^1 \cos(\pi x) dx$

3. $\int_a^b -\cos^n(kx) \sin(kx) dx$

4. $\int_a^b \sin^2(x) dx$

Compute the first four terms in the Taylor series about $x = 0$ for the following functions

1. $f(x) = 1/(1 - x)$

2. $f(x) = \log(1 - x)$

Given $\mathbf{a} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$, $\mathbf{b} = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, compute the following expressions

1. $|\mathbf{a}|$

2. $|\mathbf{a} + \mathbf{b}|$

3. $\mathbf{a} \cdot \mathbf{b}$

4. $\mathbf{a} \times \mathbf{b}$

5. The component of \mathbf{a} in the direction of \mathbf{b}

Solve the following linear system of equations

$$x + 2y + 4z = 0$$

$$2x + 3y + 5z = 1$$

$$x - y + 2z = 1$$

Solve the following quadratic equations

1. $3x^2 + 3x - 5 = 1$.

2. $x^2 + 3x - 10 = 0$.