Name:
Math 163 Final Exam Study Guide
Date: April 22, 2026

Integration

1.

$$\int 5x^4 \cos(x^5 - 4) dx$$

2.

$$\int \frac{4x-5}{x^2-7x+12} dx$$

3.

$$\int \frac{x^3}{\sqrt{1+x^2}} dx$$

4.

$$\int \tan^3(\theta)\sec(\theta) d\theta$$

5.

$$\int \tan^{-1}(x)dx$$

6.

$$\int_0^{+\infty} \frac{1}{x^2}dx$$

7.

$$\int e^{3x} \cos x dx$$

8.

$$\int \sec^3(x)dx$$

Sequences & Series

11. Determine whether the series converges or diverges:

(11.1)

$$\sum_{n=1}^{\infty} \frac{(-1)^n}{n}$$

(11.2)

$$\sum_{n=1}^{\infty} \frac{2^n}{3^n}$$

(11.3)

$$\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$$

(11.4)

$$\sum_{k=1}^{\infty} \frac{\sqrt{k}}{3k+4}$$

(11.5)

$$\sum_{k=1}^{\infty} \frac{\sqrt[3]{k}}{4k^2 + 9}$$

(11.6)

$$\sum_{k=1}^{\infty} \frac{k!}{2^k}$$

(11.7)

$$\sum_{k=1}^{\infty} \sqrt{\frac{5k}{1+k}}$$

(11.8)

$$\sum_{k=1}^{\infty} [27^{1/k} - 27^{1/(k+2)}]$$

Taylor & Maclaurin

1. Taylor:

(1.1) Find fourth degree Taylor polynomial for the function

$$f(x) = \sin(x-1) \text{ at } x = 2$$

.

(1.2) Find the interval of convergece for the power series below:

$$\gamma(x) = x - \frac{1}{4}x^4 + \frac{1}{7}x^7 - \cdots = \sum_{n=0}^{\infty} \frac{(-1)^n}{3n+1}x^{3n+1}$$

(1.3) Using the $\gamma(x)$ from the previous problem find the limit

$$\lim_{x \to 0} \frac{\gamma(x) - x}{x^4}$$

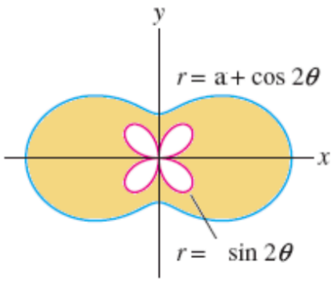
(1.4) Use a seventh degree polynomial to estimate

$$\int_0^1 \gamma(x)dx$$

(1.5) Show that if $\sum_{n=0}^{\infty} a_n$ is convergent, then $\lim_{n\to\infty} a_n = 0$.

(1.6) Find the Maclaurin series representation of the function $f(x) = \ln(x-1)$.
(Show your work, i.e., derive the series from scratch)

Parametric, Polar & Differential Equations



5. Assume $a = 21$ in the figure above. Find the area between the two curves.

6. Compute the arc length of a circle centered at the origin of radius 10 using polar coordintes.

7. Solve the following initial value problem:

$$x\frac{dy}{dx} = y - 2x, y(2) = 1$$

8. Solve the following initial value problem:

$$(1-3t)\frac{dy}{dt} - 2y = 0, y(2) = 5$$