Math F252 Midterm II Spring 2026

Name: _____

Rules:

You have 90 minutes to complete this midterm.

Partial credit will be awarded, but you must show your work.

Calculators are not allowed.

Place a box around your FINAL ANSWER to each question, or use the box provided.

Turn off anything that might go beep during the exam.

You may bring one page of hand-written notes (8.5×11in paper, single side).

Good luck!

Problem	Possible	Score
1	16	
2	18	
3	12	
4	12	
5	12	
6	6	
7	6	
8	18	
Extra Credit	*3*	
Total	100	

1. Compute and simplify the improper integrals, or show they diverge. Use correct limit notation.

(a) (*8 pts*) $\displaystyle\int_0^\infty xe^{-x}dx =$

(b) (*8 pts*) $\displaystyle\int_1^2 \frac{dx}{\sqrt{2-x}} =$

2. Do the following series converge or diverge? Show your work, including naming any test you use.

(a) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{(n!)^2}{(2n)!}$

(b) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{(\ln n)^{2n}}{n^n}$

(c) (*6 pts*) $\displaystyle\sum_{n=2}^{\infty} \frac{(-1)^n}{\ln n}$

3. Do the following series converge absolutely, conditionally, or neither(diverge)? Show your work, identify any test(s) you use, and circle one answer.

(a) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n!}$

CONVERGES ABSOLUTELY | CONVERGES CONDITIONALLY | DIVERGES

(a) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{(-1)^{n} \ln n}{n}$

CONVERGES ABSOLUTELY | CONVERGES CONDITIONALLY | DIVERGES

4. Find the **radius** and **interval** of convergence of the following power series. Show your work, identify any test(s) you use, and write your answers in the provided boxes.

(a) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{n^2 x^n}{2^n}$

$R =$	interval:

(b) (*6 pts*) $\displaystyle\sum_{n=1}^{\infty} \frac{n!}{n^n} x^n$

$R =$	interval:

5. Show your work.

(a) (*6 pts*) Find a simplified power series representation for the function $f(x) = \dfrac{x^2}{2-x}$.

(b) (*6 pts*) If $f(x) = \displaystyle\sum_{n=1}^{\infty} \frac{(-1)^{n-1}x^n}{n}$, find $f'(x)$ and simplify your answer.

6. (*6 pts*) Find a simplified power series of the function $f(x) = \dfrac{4}{(x-3)(x+1)}$.

7. (*6 pts*) Evaluate $\displaystyle\sum_{n=1}^{\infty} \frac{n}{2^n}$ by using the derivative of $f(x) = \displaystyle\sum_{n=0}^{\infty} x^n$.

8. (a) (*6 pts*) Find the Taylor polynomial of degree two approximating $f(x) = e^x$ centered at $a = 0$.

(b) (*6 pts*) Find the Taylor series for $f(x) = e^x$ centered at $a = 2$.

(c) (*6 pts*) Find the MacLaurin series for $f(x) = \sin(2x)$.

Extra Credit. (*3 pts*) Find a power series representation of $f(x) = \arctan(x)$. Show your work. (**Hint:** Using Taylor's formula for the coefficients is **not** required.)

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