Math 241, Exam 3, Spring, 2023

You should KEEP this piece of paper. Write everything on the **blank paper provided**. Return the problems **in order** (use as much paper as necessary), use **only one side** of each piece of paper. Number your pages and write your name on each page. Take a picture of your exam (for your records) just before you turn the exam in. I will e-mail your grade and my comments to you. I will keep your exam. **Fold your exam in half** before you turn it in.

The exam is worth 50 points. **Make your work coherent, complete, and correct.** Please $\boxed{CIRCLE}$ your answer. Please **CHECK** your answer whenever possible.

The solutions will be posted later today.

No Calculators, Cell phones, computers, notes, etc.

(1) (8 points) Find the point on the line

$$x = t, \quad y = 2t + 1, \quad z = 4t + 3$$

which is closest to the point $(1, 6, 16)$. **DEMONSTRATE that your answer is correct.**

(2) (8 points) Find the maximum and minimum of $f = 3x+4y$ on $x^2+y^2 = 1$.

(3) (8 points) Find the absolute extreme points of

$$f(x, y) = x^2 + xy + y^2 - 3x + 3y$$

on the triangular region cut from the first quadrant by the line $x+y = 4$.

(4) (8 points) Find the local maxima, local minima, and saddle points of $f(x, y) = 2x^3 + 3xy + 2y^3$.

(5) (9 points) Find the area of the region bounded by $x = -y^2$ and $y = x+2$. (You must draw a meaningful picture.)

(6) (9 points) Find the length of the curve whose position vector at time t is

$$\vec{\boldsymbol{r}}(t) = (2\cos t)\,\vec{\boldsymbol{i}} + (2\sin t)\,\vec{\boldsymbol{j}} + 2t\,\vec{\boldsymbol{k}},$$

for $0 \leq t \leq \frac{\pi}{4}$.