Math 241, Exam 3, Spring, 2022

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: problems one to four are worth 8 points each; problems five and six are worth 9 points each.

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) Find the point on the plane $x + 2y + 3z = 4$ which is closest to the point $(1, 4, 6)$.

(2) An object moves on the xy-plane. The position vector of the object at time t is $\overrightarrow{\boldsymbol{r}}(t) = t^2\,\overrightarrow{\boldsymbol{i}} + t^3\,\overrightarrow{\boldsymbol{j}}$. How far does the object travel between $t = 0$ and $t = 1$?

(3) Find the directional derivative of the function $f(x, y) = x^2 + 3y^2$ in the direction of $\overrightarrow{\boldsymbol{u}} = 2\,\overrightarrow{\boldsymbol{i}} + 3\,\overrightarrow{\boldsymbol{j}}$ at the point $P = (3, 4)$.

(4) Find the equation of the plane tangent to $z = 3x^2 + y^2$ at the point where $x = 1$ and $y = 2$.

(5) Find all local maximum points, local minimum points, and saddle points of $f(x, y) = 4 + x^3 + y^3 - 3xy$.

(6) Find the absolute maximum and minimum values of the function $f(x, y) = -x^2 - y^2 + 2x + 2y + 1$ on the triangular region in the first quadrant bounded by the lines $x = 0$, $y = 0$, and $y = 2 - x$.