Math 241,   Exam 2,   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. Each problem is worth 10 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) Find an equation for the plane through the points $P_1 = (1, 1, 1)$, $P_2 = (2, 4, 5)$, and $P_3 = (3, -1, 2)$. **Check your answer. Make sure it is correct.**

(2) Find $\frac{\partial}{\partial x}\left(x^2 y \cos^2(3x^3 y + e^{xy})\right)$.

(3) An object moves in three space. The position vector of the object at time t is $\overrightarrow{r}(t) = 2t^2\,\overrightarrow{i} + 3t^3\,\overrightarrow{j} + 4t^4\,\overrightarrow{k}$. Find parametric equations for the line tangent to the path of the object when the object stands at the point $(2, 3, 4)$.

(4) An object moves in three space. The position vector of the object at time t is $\overrightarrow{r}(t) = \cos(3t)\,\overrightarrow{i} + \sin(3t)\,\overrightarrow{j} + t\,\overrightarrow{k}$. How far does the object travel between $t = 0$ and $t = 2\pi$?

(5) Name, graph, and describe the set of points in 3-space that satisfy the equation $z^2 = x^2 + y^2$.