Math 2605, **First Exam Practice Problem Set**

1. Find a parametric representation of the line given by the system of equations:

$$\begin{cases} x + 2y + 5z &= 1 \\ 3x - 4y - 5z &= 3 \end{cases}$$

2. Given a parametric representation of the line $\boldsymbol{x}(t) = (1, -1, 1)^T + t(2, 0, 1)^T$, write down a representation in terms of the system of equations of two planes.

3. Determine whether the line $\boldsymbol{x}(t) = (-2, 3, 2)^T + t(3, -4, 1)^T$ intersects the plane $4x + 4y - 2z = 5$. If so, then at what point?

4. Consider the line given by

$$\begin{aligned} 2x - y + 3z &= 4 \\ x + y + z &= 2 \end{aligned}$$

   Find a parametric representation of the line obtained by reflecting this line through the plane

$$x + 3y - z = 1.$$

5. Find the distance from the point $(1, 2, -1)$ to the plane $2x + 3y + 5z = 0$. Find an equation for the plane passing through the given point and parallel to the given plane.

6. Find the distance from the point $\boldsymbol{x}_0 = (2, 1, 3)$ to the line

$$\boldsymbol{x}(t) = (1, 2, 3)^T + t(1, -1, 1)^T.$$

7. Find the distance between two lines
   $\boldsymbol{x}(s) = (s - 1, s + 1, s)^T$ and $\boldsymbol{x}(t) = (1 - t, 1 + t, 1 + t)^T$.

8. Consider the curve given by $x^4 + y^4 + 4xy = 0$. Find all points on the curve where the tangent line is vertical.

9. Consider the graph of $f(x, y) = \sqrt{(x - 3)^2 + (y - 2)^2 + 1}$. Find a point on this surface where the tangent plane is horizontal (i.e. parallel to the xy plane). Write an equation for the tangent plane at that point.

10. Let $f(x, y) = 2x^2 + 2y^2 + 3xy - x + y - 1$. Find the gradient of f, the critical points, and Hessian at these points. For each point determine whether it is a local max, local min, or saddle point.