# Parametrized Surfaces- HW Problems

1. Let a surface $S$ be parametrized by $\overrightarrow{\Phi}(u,v) =< u^2, u+v, v^2 >$; $u, v \in \mathbb{R}$.

a. Determine where $S$ is smooth (ie regular).

b. Find an equation of a tangent plane to $S$ at the point $(1,3,4)$.

2. Let a surface $S$ be parametrized by

$$\overrightarrow{\Phi}(u,v) =< u^2 + v^2,\ v,\ u^2 - v^2 >; \quad u, v \in \mathbb{R}.$$

a. Determine where $S$ is smooth

b. Find an equation of a tangent plane to $S$ at the point $(u,v) = (2,1)$

3. Let a surface $S$ be parametrized by $\overrightarrow{\Phi}(u,v) =< u^2,\ v^2,\ 2u - v >$; $u, v \in \mathbb{R}$.

a. Find an equation of a tangent plane to $S$ at the point $(4,1,3)$.

b. Find a unit normal vector to $S$ at $(4,1,3)$.

4. Let a surface $S$ be parametrized by

$$\overrightarrow{\Phi}(u,v) =< (3-\cos(v))\cos(u),\ \sin(v),\ (3-\cos(v))\sin(u) >$$

For $-\pi \le u \le \pi, \quad -\pi \le v \le \pi$.

a. Determine where $S$ is smooth.

b. Find an equation of a tangent plane to $S$ at $(u,v) = \left(\frac{\pi}{2}, \frac{\pi}{3}\right)$.

5. Find a parametrization of the surface $z = x^3 - 3xy^2$ and use it to find an equation of the tangent plane at $(1, 1, -2)$. Find a unit normal vector at $(1, 1, -2)$.