

## Gaussian Curvature and Mean Curvature- HW Problems

1. Find the Gaussian and mean curvatures for each of the following surfaces:

a.  $z = x^2 - 2y^2$  (hyperbolic paraboloid)

b.  $x^2 + y^2 = 1$  (cylinder)

c.  $\vec{\Phi}(u, v) = (u, v, u^3 - 3v^2u)$  (Monkey Saddle), find where the Gaussian curvature satisfies  $K > 0$ ,  $K < 0$ ,  $K = 0$ .

d.  $\vec{\Phi}(u, v) = ((2 + \cos(v)) \cos(u), (2 + \cos(v)) \sin(u), \sin(v))$   
where  $(u, v) \in [0, 2\pi) \times [0, 2\pi)$  (Torus).

2. Calculate the Weingarten map,  $W$ , with respect to the basis  $\{\vec{\Phi}_u, \vec{\Phi}_v\}$  for the surface given by

a.  $\vec{\Phi}(u, v) = (u, v, u^2 + v^2)$

b.  $\vec{\Phi}(u, v) = (u, v, u^2)$

c.  $\vec{\Phi}(u, v) = (v \cos(u), v \sin(u), u)$

where  $(u, v) \in \mathbb{R}^2$ .