Calc III: Workshop 11, Fall 2018

Problem 1. The *helicoid* or "spiral ramp" is a surface parameterized by $\mathbf{r}(u, v) = \langle u \cos v,\ u \sin v,\ v \rangle$, say for $0 \le v \le 2\pi$ and $0 \le u \le 1$. See if you can sketch a graph of this surface.

(a) Find the tangent plane to the helicoid at the point $(1, 0, 0)$.

(b) Set up an integral which computes its surface area. (You do not have to evaluate it!)

Problem 2. Find the surface area of the part of the plane $x + 2y + 3z = 1$ which lies inside the cylinder $x^2 + y^2 = 3$.

Problem 3. Find the surface area of the part of the cone $z = \sqrt{x^2 + y^2}$ between $z = 0$ and $z = H$.

Problem 4. Compute the flux $\iint_S \mathbf{F} \cdot \mathbf{n}\, dS$ of the vector field $\mathbf{F}(x, y, z) = xy\mathbf{i} + yz\mathbf{j} + zx\mathbf{k}$, where S is the part of the paraboloid $z = 4 - x^2 - y^2$ lying over the square $0 \le x \le 1$, $0 \le y \le 1$ and has upward orientation.

Problem 5. Compute the flux $\iint_S \mathbf{F} \cdot \mathbf{n}\, dS$ of the vector field $\mathbf{F}(x, y, z) = -x\mathbf{i} - y\mathbf{j} + z^3\mathbf{k}$ where S is the part of the cone $z = \sqrt{x^2 + y^2}$ between the planes $z = 1$ and $z = 3$ with downward orientation.