GUC
German University in Cairo
الجامعة الألمانية بالقاهرة

Mathematics Department

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Winter 2022

Math 301
Assignment 3

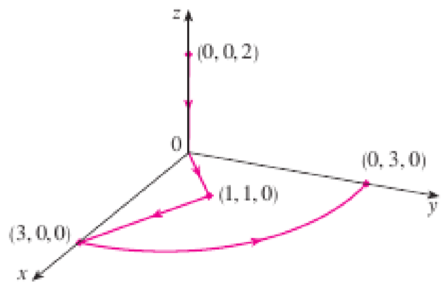
Student ID:

Tutorial N$^{\underline{\circ}}$:

Instructions

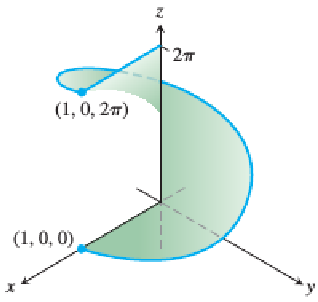
- **Answer** all questions on a **printout** of this document
- **Submit** a hard copy of your assignment to your TA no later than **Thursday 08/12/2022**. No excuse policy for late submission
- Answer all questions and show all the details of your work for full credit

1. Evaluate $\int_C \mathbf{F}.d\mathbf{r}$ in two different methods, where $\mathbf{F}(x,y,z) = (3x^2yz - 3y)\mathbf{i} + (x^3z - 3x)\mathbf{j} + (x^3y + 2z)\mathbf{k}$ and C is the curve with initial point $(0,0,2)$ and terminal point $(0,3,0)$ shown in the figure



2. Consider the helicoidal surface $\mathcal{S}$ shown in the figure, parametrized by

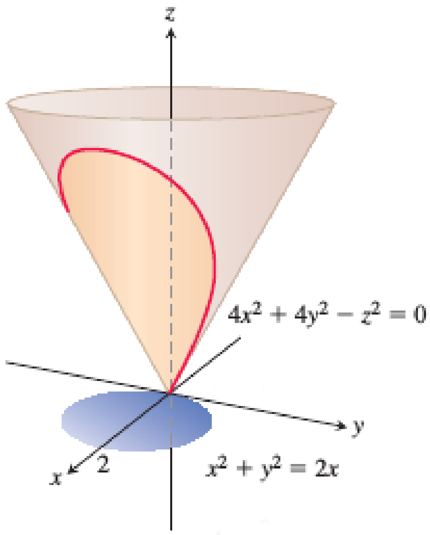
$$\mathbf{r}(r,\theta) = r\cos\theta\mathbf{i} + r\sin\theta\mathbf{j} + \theta\mathbf{k}\ ,\ \ (0 \le r \le 1,\ \ 0 \le \theta \le 2\pi).$$



(a) Find the surface area of $\mathcal{S}$.

(b) Find the mass of $\mathcal{S}$ if the density at a point is proportional to the distance from the $z-$axis.

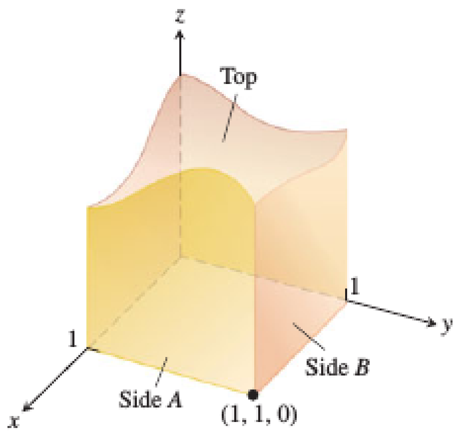
3. Let $\mathbf{F} = -z\mathbf{i} + y\mathbf{j} + x\mathbf{k}$ and consider the surface $\mathcal{S}$ cut from the shown cone by the circular cylinder $x^2 + y^2 = 2x$ and oriented by the downword pointing normal $\mathbf{N}$.



(a) Find a parametrization of $\mathcal{S}$ with the polar coordinates (r, θ) as parameters.

(b) Find $\oint_{\mathcal{C}} \mathbf{F}.d\mathbf{r}$, where $\mathcal{C}$ is the curve of intersection of the cone and the cylinder, positively oriented by $\mathbf{N}$.

4. The base of the closed cubelike surface shown here is the unit square in the $xy-$plane. The four sides lie in the planes $x = 0$, $x = 1$, $y = 0$, and $y = 1$. The top is an arbitrary smooth surface whose identity is unknown.



Let $\mathbf{F} = x\mathbf{i} - 2y\mathbf{j} + (z+3)\mathbf{k}$ and suppose the outward flux of $\mathbf{F}$ through Side A is 1 and through Side B is -3. Find the outward flux of $\mathbf{F}$ through the top side.