**MATH 10B (B. Engheta) — Final Exam Review Exercises**

You must show complete work to receive credit and your work must justify your answers.

**1.** Evaluate

$$\int_0^4 \int_{y/2}^2 e^{x^2}\, dx\, dy$$

**2.** Write the integral $\int_0^1 \int_0^x \int_0^y g(x, y, z)\, dz\, dy\, dx$ with the integration order $dx\, dy\, dz$.

**3.** Find a transformation which takes the unit square $S = [0, 1] \times [0, 1]$ to the parallelogram $P$ with vertices $(0, 0)$, $(2, 0)$, $(1, 2)$, and $(3, 2)$.

**4.** Find the image of the unit square $[0, 1] \times [0, 1]$ under the transformation $T(x, y) = (2x,\ x + 3y)$.

**5.** Find the volume enclosed by the surface $z = 1 - 9x^2 - 9y^2$ and the surface $z = \sqrt{4x^2 + 4y^2}$.

**6.** Evaluate $\int_C x + y + z\, ds$ where $C$ is the path parametrized by $(t, t^2, \frac{2}{3}t^3)$ with $0 \leq t \leq 1$.

**7.** Evaluate $\iint\limits_{\mathcal{S}} xyz\, dS$ where $\mathcal{S}$ is the surface of the tetrahedron with corners $(0,0,0)$, $(1,0,0)$, $(0,1,0)$, and $(0,0,1)$.

**8. (a)** Evaluate $\iint\limits_{\mathcal{S}} (\nabla \times \mathbf{F}) \cdot d\mathbf{S}$ where $\mathbf{F}(x,y,z) = (y,\ -x,\ x^3y^2z)$ and $\mathcal{S}$ is the surface $x^2 + y^2 + 4z^2 = 1$ with $z \leq 0$.

(Hint: You may use a theorem.)

**8. (b)** Same as part (a), but without the condition $z \leq 0$.

(Hint: Think!)

**9.** Use Green's Theorem to evaluate the line integral

$$\int\limits_{\mathcal{C}} (2x^3 - y^3)\, dx \ +\ (x^3 + y^3)\, dy$$

where $\mathcal{C}$ is the unit circle.

**10.** Evaluate $\iint\limits_{\mathcal{S}} \mathbf{F} \cdot d\mathbf{S}$ where $\mathbf{F}(x,y,z) = (x,\ y,\ z)$ and $\mathcal{S}$ is the surface of the unit cube $[0,1] \times [0,1] \times [0,1]$.