Your Name

Your Signature

Student ID #

Quiz Section

Professor's Name

TA's Name

- CHECK that your exam contains 8 problems on 8 pages.
- This exam is closed book. You may use one $8\frac{1}{2} \times 11$ sheet of notes and a TI-30X IIS calculator. Do not share notes or calculators.
- Unless otherwise specified, you should give your answers in exact form. (For example, $\frac{\pi}{4}$ and $\sqrt{2}$ are in exact form and are preferable to their decimal approximations.)
- In order to receive full credit, you must show all of your work.
- **Place a box around YOUR FINAL ANSWER to each question.**
- If you need more room, use the backs of the pages and indicate to the reader that you have done so. DO NOT USE SCRATCH PAPER.
- Raise your hand if you have a question.

Problem	Total Points	Score
1	12	
2	14	
3	15	
4	12	

Problem	Total Points	Score
5	11	
6	12	
7	12	
8	12	
Total	100	

1. (12 points) Consider the parametric curve $\langle \cos(t^2), \sin(t^2), t \rangle$.

   (a) For which values of t does the curve intersect the surface $x^2 + y^2 = z^2$?

   (b) Are there any values of t for which the binormal to the curve at time t is parallel to the z-axis? If so, find them. If not, explain why not.

2. (14 points) Consider the polar curve given by $r = 1 + \sin(\theta)$.

   (a) Plot this curve.

   (b) Find all horizontal tangent lines to the curve.

   (c) Find the area between the x-axis and the portion of the curve below the x-axis.

3. (15 points)

   (a) Find an equation for the plane perpendicular to the line $x = 1 - t, y = t, z = 14$ and containing the point $(1, 1, 1)$.

   (b) Find an equation for the line of intersection of the planes $x + y + 2017z = 2019$ and $x - y - z = 2015$.

   (c) Do the points $(1, 2, 3)$, $(-1, 0, 1)$, $(0, 0, 0)$, and $(\pi, 0, -\pi)$ lie on a plane? Why or why not?

4. (12 points) Consider the function $z = f(x, y)$ defined implicitly by the equation $ze^z = x^2 - y^2$.

   (a) Find the partial derivatives $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$.

   (b) Find the linearization of the function $f(x, y)$ at $(1, 1)$, and use it to approximate $f(1.01, 0.98)$.

5. (11 points) Find the shortest distance from the point $P\,(0, 4, 1)$ to the cone $z = \sqrt{x^2 + y^2}$.

6. (12 points)

   (a) Evaluate the iterated integral $\int_0^1 \int_{\sqrt{x}}^1 \sin\left(y^3\right)\, dy\, dx$.

   (b) Find the volume of the solid (trumpet) that lies under the plane $z = 20$, above the plane $z = 1$, and inside the surface $z = \dfrac{1}{\sqrt{x^2 + y^2}}$.

7. (12 points) Let $f(x) = \sin(x)\, e^{\left(x-\frac{\pi}{2}\right)}$.

   (a) Find the third Taylor polynomial $T_3(x)$ based at $b = \frac{\pi}{2}$.

   (b) Find an upper bound for $|T_3(x) - f(x)|$ on the interval $[\frac{\pi}{2} - 0.1, \frac{\pi}{2} + 0.1]$.

   (c) Let $T_7(x)$ be the seventh Taylor polynomial for $f(x)$ based at $b = \frac{\pi}{2}$. What is the smallest value of $|T_7(x) - f(x)|$ on the interval $[0, \pi]$?

8. (12 points) Consider the functions $f(x) = xe^{x^2} - \arctan(x)$ and $F(x) = \int_0^x f(t)\,dt$.

   (a) Find the Taylor series for $F(x)$ based at $b = 0$ (use sigma notation).

   (b) Find the open interval on which the series in (a) converges.

   (c) Find $F^{(6)}(0)$. Give an exact answer.