Student Name:

- The quiz is closed book, closed notes, and calculator free. No form of collaboration or help is allowed.
- The quiz is **45 minutes** long. This time includes downloading, working on, and submitting a quiz **in a PDF format via Gradescope**.
- The quiz will be available starting from **5:00 PM until midnight** on scheduled week day (Thursday).
- The quiz have **20 points** in total.
- There is **no extension or quiz retake**.
- Show your full work to receive a full credit on each problem.

1. **[5 points]** Find the **length** of the following curve

$$r(t) = \mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}, \quad 0 \leq t \leq 1$$

2. **[5 points]** Find the unit tangent **T(t)** and the unit normal **N(t)** vectors for the given vector function at $t = 0$:

$$r(t) = \langle t, 3\sin t, 3\cos t \rangle$$

3. **[5 points]** Find the velocity and speed of a particle with the given position function

$$r(t) = \langle t^2, 2t, \ln t \rangle$$

4. **[5 points]** Find the **tangential** and **normal** components of the **acceleration** vector for the following vector function

$$r(t) = t\,\mathbf{i} + t^2\,\mathbf{j} + t^3\,\mathbf{k}$$