Instructions

- Homework will NOT be accepted through email or in person. Homework must be submitted through CourseWare BEFORE the deadline.
- Submit the completed assignment at [http://www.casa.uh.edu](http://www.casa.uh.edu) under "EMCF" and choose LecAlt04.

For #1 – 2, Interpret \( r(t) \) as the position of a moving object at time \( t \).

\[
\mathbf{r}(t) = \sin(2t)\mathbf{i} + \cos(2t)\mathbf{j} - \sqrt{5}t\mathbf{k}
\]

1. Find the unit tangent vector
   a. \( \mathbf{T}(t) = \cos(2t)\mathbf{i} - \sin(2t)\mathbf{j} \)
   b. \( \mathbf{T}(t) = \cos(2t)\mathbf{i} - \sin(2t)\mathbf{j} - \sqrt{5}\mathbf{k} \)
   c. \( \mathbf{T}(t) = \frac{2}{3} \cos(2t)\mathbf{i} - \frac{2}{3} \sin(2t)\mathbf{j} - \frac{\sqrt{5}}{3}\mathbf{k} \)
   d. \( \mathbf{T}(t) = \frac{2}{\sqrt{13}} \cos(2t)\mathbf{i} - \frac{2}{\sqrt{13}} \sin(2t)\mathbf{j} - \frac{\sqrt{5}}{\sqrt{13}}\mathbf{k} \)
   e. None of these

2. Find the principal normal vector
   a. \( \mathbf{N}(t) = -\sin(2t)\mathbf{i} - \cos(2t)\mathbf{j} \)
   b. \( \mathbf{N}(t) = \sin(2t)\mathbf{i} + \cos(2t)\mathbf{j} \)
   c. \( \mathbf{N}(t) = -\frac{4}{3} \sin(2t)\mathbf{i} - \frac{4}{3} \cos(2t)\mathbf{j} \)
   d. \( \mathbf{N}(t) = -\frac{4}{3} \cos(2t)\mathbf{i} - \frac{4}{3} \sin(2t)\mathbf{j} \)
   e. None of these

3. The length of the curve \( \mathbf{r}(t) = (t \sin t + \cos t)\mathbf{i} + (t \cos t - \sin t)\mathbf{j} + \frac{\sqrt{3}}{2}t^2\mathbf{k} \) for \( 0 \leq t \leq 2 \) is
   a. 2
   b. 4
   c. 2/3
   d. 3
   e. None of the above
4. Suppose \( \mathbf{r}(t) \) is a parameterization for a curve \( C \) such that \( \mathbf{r}'(t) \neq \mathbf{0} \) and \( \mathbf{T}'(t) \neq \mathbf{0} \) for all \( t \). The principal normal vector \( \mathbf{N}(t) \) will always be ____ to \( \mathbf{T}'(t) \).
   a. Adjacent
   b. Co-linear
   c. Parallel
   d. Perpendicular
   e. None of the above

5. Suppose a curve \( C \) is parameterized by \( \mathbf{r}(t) = x(t)\mathbf{i} + y(t)\mathbf{j} + z(t)\mathbf{k} \), such that \( x'(t), y'(t), \) and \( z'(t) \) are continuous functions and \( \| \mathbf{r}'(t) \| \neq 0 \) for all \( t \). This parameterization would be called:
   a. Slick
   b. Soft
   c. Smooth
   d. Swift
   e. None of these

6. Given a parameter value \( t_0 \) for a parameterized curve \( C \), parameterized by \( \mathbf{r}(t) \), which of the following is not necessarily within the osculating plane corresponding to this time \( t_0 \)?
   a. \( \mathbf{r}(t_0) \)
   b. \( \mathbf{r}'(t_0) \)
   c. \( \mathbf{N}(t_0) \)
   d. \( \mathbf{T}(t_0) \)
   e. None of these

7. – 10. Choose A