# MATH 2415 Calculus of Several Variables

Fall-2019

**PLTL-Week#5** (Sec 13.2, 13.3, 14.1)

---

1. Given vector function $\mathbf{r}(t) = \langle t^2 - 2t, 1 + 3t, \frac{1}{3}t^3 + \frac{1}{2}t^2 \rangle$
   (a) Find $\mathbf{r}'(t)$
   (b) Find the unit tangent vector to the curve of $\mathbf{r}(t)$ at $t = 3$.
   (c) Find the vector equation of the tangent line to the curve at $t = 3$.
2. Find the equation of the tangent line to the curve of vector function $\mathbf{r}(t) = 2\sin t\mathbf{i} + 3\cos t\mathbf{j} + 4t\mathbf{k}$ at the point
   (a) when the parameter $t = \frac{\pi}{4}$
   (b) $(2, 0, 2\pi)$
   (c) $(0, -3, 4\pi)$
   (d) $\left(\sqrt{2}, -\frac{3\sqrt{2}}{2},\ 3\pi\right)$
3. Find the velocity and acceleration vector of a moving object with position vector $\mathbf{r}(t) = 2\sin t\mathbf{i} + 3\cos t\mathbf{j} + 4t\mathbf{k}$ (a) when the time $t = \frac{\pi}{4}$ (b) when the object is at $(2, 0, 2\pi)$.
4. Find the length of the following curves:
   (a) $\mathbf{r}(t) = 2\cos t\mathbf{i} + 2\sin t\mathbf{j} + 9\mathbf{k};\quad 0 \le t \le 3$
   (b) $\mathbf{r}(t) = 2\cos t\mathbf{i} + 2\sin t\mathbf{j} + 2\ln(\cos t)\mathbf{k};\quad 0 \le t \le \frac{\pi}{4}$
   (c) $\mathbf{r}(t) = t^2\mathbf{i} + 2t\mathbf{j} + \ln t\mathbf{k};\ 1 \le t \le 4$
   (d) $\mathbf{r}(t) = t^2\mathbf{i} + 9t\mathbf{j} + 4t^{\frac{3}{2}};\ 1 \le t \le 4$
5. Find the length of the curve of intersection of the surfaces $x^2 = 2y$ and $3z = xy$ from $(0, 0, 0)$ to $(6, 18, 36)$.
6. Sketch the graph of the following functions:
   (a) $f(x, y) = 2x + 3y - 10$
   (b) $f(x, y) = 4x^2 + y^2 - 1$
   (c) $f(x, y) = \sqrt{4x^2 + y^2 - 1}$
   (d) $f(x, y) = \cos x$
7. Draw a contour map of the function showing the level curves with given values of $k$
   (a) $f(x, y) = 3x - 2y + 1;\ k = -2, -1, 0, 1, 2$
   (b) $f(x, y) = x^2 - y^2;\ k = -4, -3, -2, -1, 0, 1, 2, 3, 4$
   (c) $f(x, y) = 4x^2 + y^2 - 1;\ k = -1, 0, 1, 2, 3, 4$
   (d) $f(x, y) = 3xe^{2y};\ k = -4, -3, -2, -1, 0, 1, 2, 3, 4$

8. Following questions from the textbook section 14.1: (EX 14.1, page 900-902)

$$32, 41, 42, 43, 44, 61, 62, 63, 64, 65, 66$$