# MTH 212 - MULTIVARIATE CALCULUS - STUDY GUIDE FOR EXAM I

*No books, notes, calculators, or cell phones are permitted during the test!*

*Use notes, text, homework, and suggested exercises to prepare for the test.*

- Chapter 10: "Parametric Equations and Polar Coordinates".
  - Section 10.1:
    - Parametrization of a plane curve by $x = f(t)$, $y = g(t)$, where $t$ is a parameter.
    - Sketching parametric curves using tables of values.
    - Identifying parametric curves by eliminating the parameter $t$ and obtaining a Cartesian equation in $x$ and $y$.
    - Finding intersection and collision points.
  - Section 10.2:
    - Finding slopes of a parametric curve by $y' = dy/dx = \frac{dy/dt}{dx/dt}$ (provided $dx/dt \neq 0$) and an equation of a tangent line with the computed slope.
    - Finding the second derivative using the formula $d^2y/dx^2 = \frac{d(y')/dt}{dx/dt}$.
    - Finding the area enclosed by parametric curve (see Example 3 on page 565).
    - Finding the length of a parametric curve by $L = \int_a^b \sqrt{[dx/dt]^2 + [dy/dt]^2}\ dt$.
      *(Do not forget: for areas and lengths, you can use symmetry of a curve!)*
    - Finding areas of surfaces of revolution:
      about $x$-axis ($y \geq 0$): $S = \int_a^b 2\pi y \sqrt{[dx/dt]^2 + [dy/dt]^2}\ dt$
      about $y$-axis ($x \geq 0$): $S = \int_a^b 2\pi x \sqrt{[dx/dt]^2 + [dy/dt]^2}\ dt$
  - Section 10.3:
    - Polar coordinates $(r, \theta)$.
    - Equations in polar coordinates; converting equations between polar and cartesian coordinates using $x = r\cos\theta$, $y = r\sin\theta$, $r^2 = x^2 + y^2$, $\tan\theta = y/x$.
  - Section 10.4:
    - Graphing a curve in polar coordinates: use symmetry and table of values $(r, \theta)$.
    - Finding a slope of a curve $r = f(\theta)$ using the slope formula from Section 10.2 ($y' = dy/dx = \frac{dy/dt}{dx/dt}$) for parametric equations $x(t) = f(\theta)\cos\theta$ and $y = f(\theta)\sin\theta$.
  - Section 10.5:
    - Finding the area of the fan-shaped region between the origin and a curve $r = f(\theta)$ by $\alpha \leq \theta \leq \beta$: $A = \int_\alpha^\beta (1/2) r^2\ d\theta$.
    - Finding the area between two polar curves $0 \leq r_1(\theta) \leq r_2(\theta)$, $\alpha \leq \theta \leq \beta$ by $A = \int_\alpha^\beta (1/2)(r_2^2 - r_1^2)\ d\theta$.
    - Finding the length of a polar curve $r = f(\theta)$, $\alpha \leq \theta \leq \beta$ by $L = \int_\alpha^\beta \sqrt{r^2 + [dr/d\theta]^2}\ d\theta$.
      *(Do not forget: for areas and lengths, you can use symmetry of a curve!)*

- Appendix A.4 and Section 10.6:
  General equations for the conics: ellipses, hyperbolas, and parabolas in Cartesian and polar coordinates.

- Chapter 11: "Vectors and the Geometry of Space".
  - Section 11.1:
    * Three-dimensional Cartesian/rectangular coordinate system.
    * Finding distance between two points $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$ by $|P_1P_2| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$.
    * The standard equation for the sphere of radius $a$ and center $(x_0, y_0, z_0)$: $(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = a^2$.