Calculus III Exam I Review

Chapter 11 - Vectors

- Sections 11.1 and 11.2
  - These sections see the development of vector algebra in 2 and 3 dimensions. Be familiar with the following.
    - Add, subtract, and scalar multiply vectors geometrically and algebraically.
    - You need to be able to find the length/norm of any vector as well as normalize a vector.
    - Know about unit vectors (see normalization above) and directions.
      - Know the standard unit vectors $i$, $j$, and $k$. Know that all vectors can be written in terms of these standard unit vectors.
      - Know the triangle inequality.
      - Know how to find the vector from a point $P$ to a point $Q$.
      - Know what is means for two vectors to be parallel.
      - Be able to find the center and radius of a sphere given its equation.
    - Problems for 11.1: 1 - 37
    - Problems for 11.2: 1 - 50

- Section 11.3 - The Dot Product
  - This section introduces the dot product of two vectors in 2 and three dimensions.
    - Be able to calculate the dot product of any two vectors.
    - Be familiar with the algebraic properties of the dot product.
    - Know how to find the angle between vectors using the dot product.
    - Know how to use the dot product to determine when vectors are orthogonal.
    - Be able to calculate the projection of one vector onto/along another vector.
    - Know the Cauchy-Schwarz inequality.
    - I will not ask about direction cosines.
  - Problems: 1 - 22, 29 - 40, 49

- Section 11.4 - The Cross Product
  - This section introduces the cross product in 2 and 3 dimensions. The triple product is also discussed.
    - Be able to use a determinant to calculate the cross product of two vectors.
    - Know that the norm of the cross product gives area and be able to calculate the area of a parallelogram spanned by two vectors.
    - Be able to calculate the volume of a parallelepiped using the triple product.
    - Know how to use the cross product to determine if two vectors are parallel.
  - Problems: 1 - 42
Section 11.5 - Lines and Planes

- This section tells you how to find equations for lines and planes in space.
  - Know how to find equations - cartesian and parametric - of planes.
  - Be able to find parametric equations of lines in space. *You do not have to know symmetric eq'ns.*
- Problems: 1 - 12, 17 - 20, 25 - 28, 33 - 36, 41 - 44, 45 - 52, 57 - 64

Chapter 12 - Vector - Valued Functions

Section 12.1 - Limits, Derivatives, Continuity

- Calculus I with vector functions of one variable
  - Know how to calculate limits, derivatives, antiderivatives and definite integrals of vector functions. Calculus I and II is assumed!
  - Be able to find all intervals on which a given function is continuous.
- Problems: 1 - 48

Section 12.2 - Velocity, Speed and Acceleration

- Basic quantities obtained from a vector function.
  - Be able to calculate the velocity vector, speed, and acceleration vector as functions of $t$.
  - Know how to find the equation of the tangent line to a vector function at some value of $t$.
- Problems: 1 - 32

Section 12.3 and 12.4 - Arc Length, Tangent Vectors, Reparametrization, Normal Vectors and Curvature

- Calculus applied to space curves.
  - Know the formula for the length of the graph of a curve over an interval and be able to calculate the arc length.
  - Be able to calculate the unit tangent vector to a curve.
  - Know how to reparametrize a curve by arc length and know how to identify when a curve is parametrized by arc length.
  - Be able to calculate the principal normal via $N = \frac{r'}{|r'|}$. (This is the "easy" formula. It will work in all cases. See page 94.)
  - Know how to calculate the curvature of a curve that is parametrized by arc length; i.e. know that, for such a curve, $\kappa(s) = ||r''(s)||$ (page 97). Also know the formula for an arbitrary curve on page 98: $\kappa(t) = \frac{|r''(t)||r'(t)|}{|r'(t)|^3}$.
- Problems: 1 - 22, 39 - 42  
Section 12.3 Problems: 1 - 22, 39 - 42  
Section 12.4 Problems: 1 - 15