Lecture Schedule for MA-UY 2114
Calculus III, Fall 2021

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- ■ 9/8 Sections 12.1 & 12.2 Three-Dimensional Coordinate Systems & Vectors
  - ☐ Identify points in space, the coordinates planes and planes parallel to the coordinate planes.
  - ☐ Compute the distance between two points in space
  - ☐ Understand and identify the equation of a sphere as an extension of the distance formula in two-dimensional Cartesian coordinates and its geometric connection to circles and/or its derivation via right triangles.
  - ☐ What are vectors? Algebraic and geometric properties of vectors, displacement vectors and the unit coordinate vectors $\vec{i}, \vec{j}$, and $\vec{k}$
- ■ 9/13 Section 12.3 The Dot Product
  - ☐ Algebraic and geometric properties of the dot product.
  - ☐ Using the sign of the dot product to determine if the angle between two vectors is acute, obtuse, or forms a right angle.
  - ☐ Projections of a vectors including parallel and orthogonal projections.
- ■ 9/15 Section 12.4 The Cross Product
  - ☐ Algebraic and geometric properties of the cross product.
  - ☐ Scalar triple product and its geometric interpretation as the volume of a parallelepiped and identifying coplanar vectors.
  - ☐ Omit Torque
- ■ 9/20 Sections 12.5 & 12.6 Lines, Planes, Cylinders and Quadric Surfaces
  - ☐ Parametric equation of a line and the parametric equation of a line segment.
  - ☐ Vector equation of a plane and its linear equation
  - ☐ Identify and sketch the traces of cylinders and quadric surfaces
- ■ 9/22 Sections 13.1 & 13.2 Vector Functions
  - ☐ What is a vector-valued function?
  - ☐ Examples of space curves and plane curves.
  - ☐ Vector algebra extended to vector-valued functions.
  - ☐ Extension of basic concepts of calculus, such as limits, continuity, derivatives and integrals of scalar-valued functions to vector-valued functions.

- ☐ The tangent vector to a curve.
- ☐ Discussion of the tangent vector for plane curves, i.e., the tangent vector to a plane curve contains the slope of the tangent line.
- ☐ Omit subsection using computers to draw space curves.

■ 9/27 Section 13.3 Arc Length

- ☐ Compute the arc length of a parameterized curve. Define the arc length function and reparameterize a curve with respect to arc length.
- ☐ Consequences and interpretations of a reparameterization of a curve with respect to arc length.
- ☐ Curvature, normal, and binormal vectors.

■ 9/29 Section 13.4 Velocity and Acceleration

- ☐ Motion of a particle in 2- or 3-space: position, velocity, speed, and acceleration.
- ☐ Find the tangential and normal components of the acceleration vector.
- ☐ Examples of motion along a line, circle, ellipse, and/or helix.

■ 10/4 Section 14.1 Functions of Several Variables

- ☐ What are multivariable functions? Special attention to the importance of linear functions (planes) in multivariable calculus in analogy to linear functions (lines) in single variable calculus.
- ☐ Visualizing functions of several variables via contour maps (or level curves or level surfaces).

■ 10/6 Section 14.3 Partial Derivatives

- ☐ Emphasis on the geometric interpretation of the partial derivative.
- ☐ Partial derivatives and implicit differentiation
- ☐ Examples and interpretation of second-order derivatives, higher order-derivatives, and consequences of Clairaut's Theorem (Equality of Mixed Partial Derivatives)
- ☐ Partial Differential Equations
- ☐ Omit The Cobb-Douglas Production Function

■ 10/12 Section 14.4 Tangent Planes and Linear Approximations, Review

- ☐ Find tangent planes to surfaces.
- ☐ Geometric and analytical extension of the idea that all differentiable functions are indistinguishable from linear functions if we zoom-in sufficiently.
- ☐ Usage of the differential as an application to estimate the maximum error in a measurement.

■ 10/13 Exam

■ 10/18 Sections 14.5 & 14.6 The Chain Rule, Directional Derivatives, and the Gradient Vector

- ☐ The general version of the chain rule.
- ☐ Usage of the chain rule to further clarify implicit differentiation.
- ☐ Some implications of the Implicit Function Theorem.
- ☐ The directional derivative as a generalization of the partial derivative and its geometric interpretation.

- ☐ The gradient vector and its significance.
- ☐ The tangent plane and normal line to a surface at a point via the gradient vector.

■ 10/20 Section 14.7 Maximum and Minimum Values

- ☐ Finding and classifying local extrema as local maxima, minima, or saddle point.
- ☐ Visualization of surfaces near local extrema as paraboloids or horse saddles (hyperbolic paraboloids) and justification of the Second Derivative Test via second-order Taylor Polynomials.
- ☐ Discussion of the existence of global extrema on closed and bounded sets via the Extreme Value Theorem.
- ☐ Examples of global extrema on simple domains such as a parallelogram or triangle.

■ 10/25 Section 14.8 Lagrange Multipliers

- ☐ The method of Lagrange multipliers to solve both equality and inequality constrained optimization problems.
- ☐ The meaning and interpretation of the Lagrange multiplier as the rate of change of the optimum value.
- ☐ Solve optimization problems with two constraints.

■ 10/27 Sections 15.1 & 15.2 Double Integrals

- ☐ Double Integrals over Rectangles (Ref. Sec. 15.1 Omit The Midpoint Rule).
- ☐ Double Integrals over General Regions (Ref. Sec. 15.2).

■ 11/1 Sections 15.3 & 15.4 Double Integrals in Polar Coordinates and Applications of Double Integrals

- ☐ Double Integrals in Polar Coordinates (Ref. Sec. 15.3) with examples also including regions of integration such as triangles.
- ☐ Interpretations of the double and triple integral in the context of total mass or total electric charge via a given density function.
- ☐ Centers of Mass

■ 11/3 Section 15.6 Triple Integrals

- ☐ Triple integrals over General Regions

■ 11/8 Sections 15.7 & 15.8 Triple Integrals in Cylindrical and Spherical Coordinates

- ☐ Triple integrals in spherical and cylindrical coordinates.

■ 11/10 Sections 16.1 & 16.2 Vector Fields and Line Integrals

- ☐ Examples of vector fields in the plane and space.
- ☐ The flow of a vector field.
- ☐ Interpretation of line integrals as work and/or circulation.
- ☐ Line Integrals over parameterized paths.

■ 11/15 Sections 16.3 The Fundamental Theorem for Line Integrals and Review

- ☐ The Fundamental Theorem for Line Integrals.

■ 11/17 Exam

■ 11/22 Sections 16.4 & 16.5 Green's Theorem, Curl, & Divergence

- ☐ Green's Theorem
- ☐ Algebraic definition, properties, and implications of the curl and divergence of a vector field.
- ☐ Interpretation as a measure of rotation and spread of a vector field.
- ☐ Vector forms of Green's Theorem.

■ 11/24 Section 16.6 Parametric Surfaces and Their Areas

- ☐ Parametric surfaces in space. Examples should include but are not limited to parametric descriptions of a sphere, cylinder, and graphs in general.
- ☐ Grid curves usage in computer-generated surfaces.
- ☐ The surface area of parametric surfaces.

■ 11/29 Section 16.7 Surface Integrals

- ☐ Oriented surfaces and surface integrals of vector fields with an emphasis on its interpretation as a flux integral.
- ☐ Examples of flux integrals over cylinders, spheres, graphs, and parametric surfaces.

■ 12/1 Section 16.8 Stokes' Theorem

- ☐ Stokes' Theorem over simply connected domains
- ☐ The physical interpretation of the curl as circulation and approximating the circulation of a vector field.

■ 12/6 Section 16.9 The Divergence Theorem

- ☐ The divergence theorem over closed simple surfaces.
- ☐ Approximating the flux of a vector field through a closed surface.

■ 12/8 Section 16.10 Summary and Supplemental Notes

- ☐ Summary of the fundamental theorems
- ☐ The divergence test and the curl test

■ 12/13 Review