Calculus III

Curriculum/Content Area: Mathematics	**Course Length:** 2 Terms
Course Title: Calculus III	**Date last reviewed:** 10/2019
Prerequisites: Calculus BC	**Board approval date:** 12/2017
Primary Resource: Calculus: Early Transcendental Functions by Cengage Learning	

Desired Results

Course description and purpose: Calculus III is a study of calculus in multivariable. Topics covered in this course include vectors and the geometry of space, vector functions, partial derivatives, multiple integrals, and vector calculus. This course is the equivalent of a third-semester university Calculus course and may be taken for college credit through the UW-Oshkosh CAPP program. A TI-84 or TI-89 graphing calculator is required.

Enduring Understandings:	**Essential Questions**:
1. Mathematicians make sense of problems and persevere in solving them. 2. Mathematicians reason abstractly and quantitatively. 3. Mathematicians construct viable arguments and critique the reasoning of others. 4. Mathematicians model with mathematics. 5. Mathematicians use appropriate tools strategically. 6. Mathematicians attend to precision. 7. Mathematicians look for and make use of structure. 8. Mathematicians look for and express regularity in repeated reasoning.	1. What strategies and tools transcend all mathematical problems, and how can I apply those strategies/tools in unique settings. 2. How can I use mathematics to make sense of the world? 3. How can mathematics be used to provide models that help us interpret data and make predictions? 4. What is a mathematically precise solution? 5. How are mathematical concepts related?

Vectors and the Geometry of Space

Topics of Study:

1. Vectors in 3-Dimensions
2. Lines and Planes
3. Vector Valued Functions
4. Curvature
5. Tangential and Normal Components of Acceleration
6. Surfaces
7. Kepler's Laws

Standards:

<u>Standards for Mathematical Practice</u>

1. **MP.1** Make sense of problems and persevere in solving them.
2. **MP.2** Reason abstractly and quantitatively.
3. **MP.3** Construct viable arguments and critique the reasoning of others.
4. **MP.4** Model with mathematics.
5. **MP.5** Use appropriate tools strategically.
6. **MP.6** Attend to Precision.
7. **MP.7** Look for and make use of structure.
8. **MP.8** Look for and express regularity in repeated reasoning.

Learning Targets:

1. I can perform and apply vector operations, including the dot and cross product of vectors, in the plane and space.
2. I can graph and find equations of lines, planes, cylinders and quadratic surfaces.
3. I can differentiate and integrate vector-valued functions. For a position vector function of time, interpret these as velocity and acceleration .
4. I can find arc length and curvature of space curves, including the use of unit tangents and unit normals.
5. I can identify and interpret tangential and normal components of acceleration.

Assessment Evidence:

Performance Assessment Options *May include, but are not limited to the following:*	**Other assessment options** *May include, but are not limited to the following:*

●	● Unit Assessment
Digital Tools & Supplementary Resources:	

Partial Differentiation
Topics of Study:. 1. Functions of Several Variables 2. Limits and Continuity 3. Partial Derivatives 4. Increments and differentials 5. Chain Rules 6. Directional Derivatives 7. Tangent Planes and Normal Lines 8. Extrema of Functions of Several Variables 9. Lagrange Multipliers
Standards:
<u>Standards for Mathematical Practice</u> 1. **MP.1** Make sense of problems and persevere in solving them. 2. **MP.2** Reason abstractly and quantitatively. 3. **MP.3** Construct viable arguments and critique the reasoning of others. 4. **MP.4** Model with mathematics. 5. **MP.5** Use appropriate tools strategically. 6. **MP.6** Attend to Precision. 7. **MP.7** Look for and make use of structure. 8. **MP.8** Look for and express regularity in repeated reasoning.
Learning Targets:
1. I can evaluate limits and determine the continuity and differentiability of functions of several variables. 2. I can describe graphs, level curves and level surfaces of functions of several variables.

3. I can find partial derivatives, directional derivatives, and gradients and use them to solve applied problems.
4. I can find differentials of functions of several variables and use them to solve applied problems.
5. I can find equations of tangent planes and normal lines to surfaces that are given implicitly or parametrically.
6. I can use the chain rule for functions of several variables (including implicit differentiation).
7. I can find critical points using first partials and interpret them as relative extrema/saddle points using the second partials test for functions of several variables.
8. I can find absolute extrema on a closed region and apply these techniques to optimization problems.
9. I can use Lagrange multipliers to solve constrained optimization problems.

Assessment Evidence:

Performance Assessment Options *May include, but are not limited to the following:*	**Other assessment options** *May include, but are not limited to the following:*
●	● Unit Assessment

Digital Tools & Supplementary Resources:

Multiple Integrals

Topics of Study:.

1. Double Integrals
2. Area and Volume
3. Double Integrals in Polar Coordinates
4. Surface Area
5. Triple Integrals
6. Moments and Center of Mass
7. Cylindrical Coordinates
8. Spherical Coordinates
9. Change of Variables and Jacobians

Standards:

Standards for Mathematical Practice

1. **MP.1** Make sense of problems and persevere in solving them.
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4. **MP.4** Model with mathematics.
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Learning Targets:

1. I can evaluate multiple integrals in appropriate coordinate systems such as rectangular, polar, cylindrical and spherical coordinates and apply them to solve problems involving volume, surface area, density, moments and centroids.
2. I can use Jacobians to change variables in multiple integrals.

Assessment Evidence:

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●	● Unit Assessment

Digital Tools & Supplementary Resources:

Vector Calculus

Topics of Study:.

1. Vector Fields
2. Line Integrals
3. Independence of Path
4. Green's Theorem
5. Surface Integrals

6. The Divergence Theorem
7. Stoke's Theorem

Standards:

<u>Standards for Mathematical Practice</u>

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7. **MP.7** Look for and make use of structure.
8. **MP.8** Look for and express regularity in repeated reasoning.

Learning Targets:

1. I can evaluate line and surface integrals.
2. I can identify when a line integral is independent of path and use the Fundamental Theorem of Line Integrals to solve applied problems.
3. I can identify conservative and inverse square fields.
4. I can find the curl and divergence of a vector field, the work done on an object moving in a vector field, and the flux of a field through a surface, and I can use these ideas to solve applied problems.
5. I can introduce and use Green's Theorem, the Divergence (Gauss's) Theorem and Stokes's Theorem.

Assessment Evidence:

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●	● Unit Assessment

Digital Tools & Supplementary Resources: