# Washtenaw Community College Comprehensive Report

# MTH 293 Calculus III
# Effective Term: Winter 2025

## Course Cover

**College:** Math, Science and Engineering Tech
**Division:** Math, Science and Engineering Tech
**Department:** Math & Engineering Studies
**Discipline:** Mathematics
**Course Number:** 293
**Org Number:** 12200
**Full Course Title:** Calculus III
**Transcript Title:** Calculus III
**Is Consultation with other department(s) required:** No
**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:**
**Change Information:**
**Consultation with all departments affected by this course is required.**
**Rationale:** New materials for the course.
**Proposed Start Semester:** Winter 2024
**Course Description:** In this course, students apply knowledge learned in the first two Calculus courses to functions of two or three variables, including parametric equations and polar coordinates vectors in the plane and space, partial differentiation, double and triple integrals, surface integrals, line integrals, Green's Theorem, Stokes' Theorem, Divergence, Curl and applications. This is the third course in the standard Calculus sequence.

## Course Credit Hours

**Variable hours:** No
**Credits:** 4
**Lecture Hours: Instructor:** 60 **Student:** 60
**Lab: Instructor:** 0 **Student:** 0
**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 60 **Student:** 60
**Repeatable for Credit:** NO
**Grading Methods:** Letter Grades
Audit
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

## College-Level Reading and Writing

College-level Reading & Writing

## College-Level Math

No Level Required

## Requisites

**Prerequisite**
MTH 192 minimum grade "C"

## General Education

**Degree Attributes**

Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math

**Michigan Transfer Agreement - MTA**

MTA Mathematics

## Request Course Transfer

**Proposed For:**

Eastern Michigan University
Michigan State University
University of Michigan
Wayne State University

## Student Learning Outcomes

1. Perform basic operations of Vector Algebra.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2025
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 1.
   Who will score and analyze the data: Course lead instructor

2. Differentiate functions of two or three variables, including partial derivatives, chain rules and implicit differentiation.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2025
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 2.
   Who will score and analyze the data: Course lead instructor

3. Integrate and find limits of functions of two or three variables, using rectangular, cylindrical or spherical coordinates.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2025
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.

How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 3.
Who will score and analyze the data: Course lead instructor

4. Perform calculations in Vector Calculus using Green's Theorem, the divergence theorem and Stokes' Theorem.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2025
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 4.
   Who will score and analyze the data: Course lead instructor

5. Find relative and absolute extrema of functions of several variables using the second partial derivative test and Lagrange multipliers.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2025
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 5.
   Who will score and analyze the data: Course lead instructor

## Course Objectives

1. Add and subtract vectors in plane and space.
2. Evaluate dot/cross products of vectors.
3. Solve application problems related to dot/cross products of vectors
4. Write equations of lines and planes.
5. Find limits and derivatives of functions of more than one independent variable.
6. Find limits and derivatives of vector-valued functions.
7. Use second order partial derivatives to determine if a critical point is a relative extrema.
8. Set up and solve optimization problems with constraints using method of Lagrange multipliers.
9. Write and solve multiple integrals using an appropriate coordinate system.
10. Find length, area and volume using an appropriate integral.
11. Apply length, area and volume, and find work and flux using an appropriate integral.
12. Solve multiple integrals by substitution method or changing coordinate system.
13. Demonstrate an understanding of the Fundamental Theorem for Line Integrals and the relationship between line integrals of conservative vector fields.
14. Demonstrate an understanding of the Fundamental Theorem for Line Integrals and Green's Theorem in Vector Calculus.
15. Demonstrate an understanding of the divergence theorem and Stokes' Theorem in Vector Calculus.

## New Resources for Course

## Course Textbooks/Resources

Textbooks

Strang, Herman. *Calculus Volume 3*, ed. Texas: Montezuma Publishing, 2023, ISBN: 13: 978-.

Manuals

Periodicals

Software

MY OPEN MATH. OMy Open Math, ? ed.

MyOpenMath is an online course management and assessment system for mathematics and other quantitative fields. MyOpenMath's focus is providing rich algorithmically generated assessment to support the use of free, open textbooks

## Equipment/Facilities

Level III classroom

Testing Center

Data projector/computer

| Reviewer | Action | Date |
|---|---|---|
| **Faculty Preparer:** | | |
| *Michael Quail* | *Faculty Preparer* | *Oct 20, 2023* |
| **Department Chair/Area Director:** | | |
| *Nichole Klemmer* | *Recommend Approval* | *Nov 09, 2023* |
| **Dean:** | | |
| *Tracy Schwab* | *Recommend Approval* | *Nov 09, 2023* |
| **Curriculum Committee Chair:** | | |
| *Randy Van Wagnen* | *Recommend Approval* | *Jun 27, 2024* |
| **Assessment Committee Chair:** | | |
| *Jessica Hale* | *Recommend Approval* | *Jul 05, 2024* |
| **Vice President for Instruction:** | | |
| *Brandon Tucker* | *Approve* | *Jul 05, 2024* |

# Washtenaw Community College Comprehensive Report

# MTH 293 Calculus III
# Effective Term: Fall 2022

## Course Cover

**College:** Math, Science and Engineering Tech
**Division:** Math, Science and Engineering Tech
**Department:** Math & Engineering Studies
**Discipline:** Mathematics
**Course Number:** 293
**Org Number:** 12200
**Full Course Title:** Calculus III
**Transcript Title:** Calculus III
**Is Consultation with other department(s) required:** No
**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:** Three Year Review / Assessment Report
**Change Information:**
**Consultation with all departments affected by this course is required.**
**Course description**
**Outcomes/Assessment**
**Objectives/Evaluation**
**Rationale:** Update course topics required in course credit transfer to other 4-year institutions.
**Proposed Start Semester:** Fall 2021
**Course Description:** In this course, students apply knowledge learned in the first two Calculus courses to functions of two or three variables, including parametric equations and polar coordinates vectors in the plane and space, partial differentiation, double and triple integrals, surface integrals, line integrals, Green's Theorem, Stokes' Theorem, Divergence, Curl and applications. This is the third course in the standard Calculus sequence.

## Course Credit Hours

**Variable hours:** No
**Credits:** 4
**Lecture Hours: Instructor:** 60 **Student:** 60
**Lab: Instructor:** 0 **Student:** 0
**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 60 **Student:** 60
**Repeatable for Credit:** NO
**Grading Methods:** Letter Grades
Audit
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

## College-Level Reading and Writing

College-level Reading & Writing

## College-Level Math

No Level Required

## Requisites

**Prerequisite**
MTH 192 minimum grade "C"

## General Education

**Degree Attributes**
Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math
**Michigan Transfer Agreement - MTA**
MTA Mathematics

## Request Course Transfer

**Proposed For:**
Eastern Michigan University
University of Michigan

## Student Learning Outcomes

1. Perform basic operations of Vector Algebra.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2022
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 1.
   Who will score and analyze the data: Course lead instructor

2. Differentiate functions of two or three variables, including partial derivatives, chain rules and implicit differentiation.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2022
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 2.
   Who will score and analyze the data: Course lead instructor

3. Integrate and find limits of functions of two or three variables, using rectangular, cylindrical or spherical coordinates.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2022
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections

Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 3.
Who will score and analyze the data: Course lead instructor

4. Perform calculations in Vector Calculus using Green's Theorem, the divergence theorem and Stokes' Theorem.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2022
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 4.
   Who will score and analyze the data: Course lead instructor

5. Find relative and absolute extrema of functions of several variables using the second partial derivative test and Lagrange multipliers.
   **Assessment 1**
   Assessment Tool: Outcome-related questions on the end-of-semester exam
   Assessment Date: Fall 2022
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All course sections
   Number students to be assessed: 60 samples from Final Exams collected from all sections offered during the 2-year period.
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 5.
   Who will score and analyze the data: Course lead instructor

## Course Objectives

1. Add and subtract vectors in plane and space.
2. Evaluate dot/cross products of vectors.
3. Solve application problems related to dot/cross products of vectors
4. Write equations of lines and planes.
5. Find limits and derivatives of functions of more than one independent variable.
6. Find limits and derivatives of vector-valued functions.
7. Use second order partial derivatives to determine if a critical point is a relative extrema.
8. Set up and solve optimization problems with constraints using method of Lagrange multipliers.
9. Write and solve multiple integrals using an appropriate coordinate system.
10. Find length, area and volume using an appropriate integral.
11. Apply length, area and volume, and find work and flux using an appropriate integral.
12. Solve multiple integrals by substitution method or changing coordinate system.
13. Demonstrate an understanding of the Fundamental Theorem for Line Integrals and the relationship between line integrals of conservative vector fields.
14. Demonstrate an understanding of the Fundamental Theorem for Line Integrals and Green's Theorem in Vector Calculus.
15. Demonstrate an understanding of the divergence theorem and Stokes' Theorem in Vector Calculus.

## New Resources for Course

## Course Textbooks/Resources

Textbooks

Larson, R., B. Edwards. *Calculus: Early Transcendental Functions*, 7th ed. Boston: Brooks Cole, 2015, ISBN: 9781285774770.

Manuals

Periodicals

Software

## Equipment/Facilities

Level III classroom

Testing Center

Data projector/computer

| Reviewer | Action | Date |
|---|---|---|
| **Faculty Preparer:** | | |
| *Yin Lu* | *Faculty Preparer* | *Jul 12, 2021* |
| **Department Chair/Area Director:** | | |
| *Lawrence David* | *Recommend Approval* | *Aug 09, 2021* |
| **Dean:** | | |
| *Victor Vega* | *Recommend Approval* | *Aug 10, 2021* |
| **Curriculum Committee Chair:** | | |
| *Randy Van Wagnen* | *Recommend Approval* | *Jun 16, 2022* |
| **Assessment Committee Chair:** | | |
| *Shawn Deron* | *Recommend Approval* | *Jun 21, 2022* |
| **Vice President for Instruction:** | | |
| *Victor Vega* | *Approve* | *Jul 08, 2022* |

# Washtenaw Community College Comprehensive Report

# MTH 293 Calculus III
# Effective Term: Spring/Summer 2020

## Course Cover

**Division:** Math, Science and Engineering Tech
**Department:** Math & Engineering Studies
**Discipline:** Mathematics
**Course Number:** 293
**Org Number:** 12200
**Full Course Title:** Calculus III
**Transcript Title:** Calculus III
**Is Consultation with other department(s) required:** No
**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:** Three Year Review / Assessment Report
**Change Information:**
**Consultation with all departments affected by this course is required.**
**Outcomes/Assessment**
**Other:**
**Rationale:** Three-year syllabus review.
**Proposed Start Semester:** Fall 2019
**Course Description:** This is the third course in the standard Calculus sequence. This course covers differential, integral and vector calculus for functions of more than one variable. To confirm transfer equivalency, consult a counselor or check the Web page of the college to which you are transferring. A graphing calculator is required for this course. See the time schedule for current brand and model.

## Course Credit Hours

**Variable hours:** No
**Credits:** 4
**Lecture Hours: Instructor:** 60 **Student:** 60
**Lab: Instructor:** 0 **Student:** 0
**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 60 **Student:** 60
**Repeatable for Credit:** NO
**Grading Methods:** Letter Grades
Audit
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

## College-Level Reading and Writing

College-level Reading & Writing

## College-Level Math

No Level Required

## Requisites

**Prerequisite**
MTH 192 minimum grade "C"

## General Education

**Degree Attributes**

Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math

**Michigan Transfer Agreement - MTA**

MTA Mathematics

## Request Course Transfer

**Proposed For:**

Eastern Michigan University
University of Michigan

## Student Learning Outcomes

1. Perform basic operations of Vector Algebra.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2020
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 1
   Who will score and analyze the data: Department

2. Differentiate functions of several variables.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2020
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 2
   Who will score and analyze the data: Department

3. Integrate and find limits of functions of several variables.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2020
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 3
   Who will score and analyze the data: Department

4. Perform calculations in Vector Calculus.
   **Assessment 1**
   Assessment Tool: End of semester exams
   Assessment Date: Winter 2020
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 4
   Who will score and analyze the data: Department

5. Find relative and absolute extrema of functions of several variables.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2020
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 5
   Who will score and analyze the data: Department

## Course Objectives

1. Add and subtract vectors in plane and space.
2. Evaluate dot/cross products of vectors and solve related application problems.
3. Write equations of lines and planes in space.
4. Find limits and derivatives of functions of more than one independent variable.
5. Find limits and derivatives of vector-valued functions.
6. Use second order partial derivatives to determine if a critical point is a relative extrema.
7. Set up and solve optimization problems involving several variables, with or without constraints.
8. Set up and solve optimization problems using method of Lagrange Multipliers.
9. Write and solve multiple integrals using an appropriate coordinate system.
10. Find length, area, volume, work and flux using an appropriate integral.
11. Solve multiple integrals by changing variables.
12. Demonstrate an understanding of the major theorems (Green's, Gauss' and Stokes').
13. Perform basic operations and selected applications of vector calculus, including divergence and curl.
14. Demonstrate an understanding of the Fundamental Theorem of Line integrals and the relationship between line integrals of conservative vector fields and the values of the potential function at the endpoints of the curve.
15. Perform calculations using the tangential form and normal form of Greens theorem.

## New Resources for Course

## Course Textbooks/Resources

Textbooks
Larson, R., B. Edwards. *Calculus: Early Transcendental Functions*, 7th ed. Boston: Brooks Cole, 2015, ISBN: 9781285774770.
Manuals
Periodicals
Software

## Equipment/Facilities

Level III classroom
Testing Center

| Reviewer | Action | Date |
|---|---|---|
| **Faculty Preparer:** | | |
| *Yin Lu* | *Faculty Preparer* | *Jun 04, 2019* |
| **Department Chair/Area Director:** | | |
| *Lisa Manoukian* | *Recommend Approval* | *Jun 09, 2019* |
| **Dean:** | | |
| *Kimberly Jones* | *Recommend Approval* | *Jul 02, 2019* |
| **Curriculum Committee Chair:** | | |
| *Lisa Veasey* | *Recommend Approval* | *Nov 12, 2019* |
| **Assessment Committee Chair:** | | |
| *Shawn Deron* | *Recommend Approval* | *Nov 15, 2019* |
| **Vice President for Instruction:** | | |
| *Kimberly Hurns* | *Approve* | *Nov 19, 2019* |

# Washtenaw Community College Comprehensive Report

# MTH 293 Calculus III
# Effective Term: Fall 2017

## Course Cover

**Division:** Math, Science and Engineering Tech
**Department:** Mathematics
**Discipline:** Mathematics
**Course Number:** 293
**Org Number:** 12200
**Full Course Title:** Calculus III
**Transcript Title:** Calculus III
**Is Consultation with other department(s) required:** No
**Publish in the Following:** College Catalog , Time Schedule , Web Page
**Reason for Submission:** Three Year Review / Assessment Report
**Change Information:**
**Course description**
**Outcomes/Assessment**
**Objectives/Evaluation**
**Rationale:** three year review
**Proposed Start Semester:** Fall 2017
**Course Description:** Math 293 is the third course in the standard Calculus sequence. This course covers differential, integral and vector calculus for functions of more than one variable. To confirm transfer equivalency, consult a counselor or check the Web page of the college to which you are transferring. A graphing calculator is required for this course. See the time schedule for current brand and model.

## Course Credit Hours

**Variable hours:** No
**Credits:** 4
**Lecture Hours: Instructor:** 60 **Student:** 60
**Lab: Instructor:** 0 **Student:** 0
**Clinical: Instructor:** 0 **Student:** 0

**Total Contact Hours: Instructor:** 60 **Student:** 60
**Repeatable for Credit:** NO
**Grading Methods:** Letter Grades
Audit
**Are lectures, labs, or clinicals offered as separate sections?:** NO (same sections)

## College-Level Reading and Writing

College-level Reading & Writing

## College-Level Math

No Level Required

## Requisites

**Prerequisite**
MTH 192 minimum grade "C"

## General Education

**Degree Attributes**

Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math

**Michigan Transfer Agreement - MTA**

MTA Mathematics

## Request Course Transfer

**Proposed For:**

Eastern Michigan University
University of Michigan

## Student Learning Outcomes

1. Perform basic operations of Vector Algebra.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2017
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 1.
   Who will score and analyze the data: Department

2. Differentiate functions of several variables.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2017
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 2.
   Who will score and analyze the data: Department

3. Integrate functions of several variables.
   **Assessment 1**
   Assessment Tool: End of semester exam
   Assessment Date: Winter 2017
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All course sections
   Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 3.
   Who will score and analyze the data: Department

4. Perform calculations in Vector Calculus.

**Assessment 1**

Assessment Tool: End of semester exams
Assessment Date: Winter 2017
Assessment Cycle: Every Three Years
Course section(s)/other population: All course sections
Number students to be assessed: A random sample of 20% of students enrolled or a minimum of 30 students
How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 70% of students sampled will score an average of 70% or higher on each exam question that addresses Outcome 4
Who will score and analyze the data: Department

## Course Objectives

1. Add and subtract vectors in plane and space.
2. Evaluate dot/cross products of vectors and solve related application problems.
3. Write equations of lines and planes in space.
4. Find limits and derivatives of functions of more than one independent variable.
5. Find limits and derivatives of vector-valued functions.
6. Use second order partial derivatives to determine if a critical point is a relative extrema.
7. Set up and solve optimization problems involving several variables, with or without constraints.
8. Set up and solve optimization problems using method of Lagrange Multipliers.
9. Write and solve multiple integrals using an appropriate coordinate system.
10. Find length, area, volume, work and flux using an appropriate integral.
11. Solve multiple integrals by changing variables.
12. Demonstrate an understanding of the major theorems (Green's, Gauss' and Stokes') and perform basic operations and selected applications of vector calculus, including divergence and curl.
13. Demonstrate an understanding of the Fundamental Theorem of Line integrals and the relationship between line integrals of conservative vector fields and the values of the potential function at the endpoints of the curve.
14. Make calculations using the tangential form and normal form of Greens theorem.

## New Resources for Course

## Course Textbooks/Resources

Textbooks

Larson, R., B. Edwards. *Calculus:Early Transcendental Functions*, 6th ed. Boston: Brooks Cole, 2015, ISBN: 9781285774770.

Manuals
Periodicals
Software

## Equipment/Facilities

Level III classroom

| Reviewer | Action | Date |
|---|---|---|
| **Faculty Preparer:** | | |
| *Frank Gerlitz* | *Faculty Preparer* | *Dec 05, 2016* |
| **Department Chair/Area Director:** | | |
| *Lisa Rombes* | *Recommend Approval* | *Dec 13, 2016* |
| **Dean:** | | |
| *Kristin Good* | *Recommend Approval* | *Dec 14, 2016* |

| | | |
|---|---|---|
| **Curriculum Committee Chair:** | | |
| *David Wooten* | *Recommend Approval* | *Mar 21, 2017* |
| **Assessment Committee Chair:** | | |
| *Ruth Walsh* | *Recommend Approval* | *Mar 22, 2017* |
| **Vice President for Instruction:** | | |
| *Kimberly Hurns* | *Approve* | *Mar 23, 2017* |