**Calculus MAT 540**

**Resource(s) used:**

**Primary:** Calculus - 4th edition, Larson, Hostetler, Edwards, D.C.Heath Publishing

The course teaches all topics associated with functions, graphs, and limits; derivatives; and integrals as delineated in the Calculus Topic Outline in the Course Description Guide. Student conceptual development of topics builds on numerical, graphical, analytical and verbal connections. The first half of this course includes differentiated and integral calculus. The material is similar to a first semester college calculus course. Four credit hours are available from NCCC. Pre-calculus is a prerequisite for the course.

 **Final Assessment**: These students will be required to take a NFCSD final exam.

At the completion of this course the student will:

* Evaluate limits, demonstrate an understanding of continuity, and calculate derivatives using the formal definition.
* Use theorems of differentiation to find derivatives of polynomials, products, quotients, powers, the six basic trigonometric functions, and demonstrate use of the chain rule.
* Use implicit differentiation to find derivatives and to solve application problems involving related rates.
* Demonstrate an understanding of the significance of derivatives to graphing and use these concepts to solve optimization problems.
* Use techniques of integration to find indefinite integrals of polynomials, powers, and anti-derivatives of the derivatives of the six basic trigonometric functions.
* Find general and particular solutions for simple differential equations.
* Calculate definite integrals using the Fundamental Theorem of Integral Calculus and use this technique to solve application problems.

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| **Topic(s)**  | **Sections** | **Additional Resources**  |
| **I****REVIEW OF FUNCTIONS** | 1. Definition
2. Domain and Range
3. Composite Function and the Algebra of Functions
4. Linear Functions (quickly review)
5. Slope
6. Parallel and Perpendicular Lines
7. Equation of Lines
8. Polynomial Functions (quickly review)
9. Square Root Functions (quickly review)
10. Rational Functions (quickly review)
11. Piecewise Defined Functions
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| **II****LIMITS AND CONTINUITY**  | 1. Intuitive idea of a limit: graphically and numerically
2. Formal Definition (optional)
3. Basic Properties
4. Techniques for evaluating limits including removable discontinuities
5. Trigonometric Limits:
6. Evaluating one-sided limits: graphically, piece-wise functions
7. Infinite Limits
8. Limits at Infinity
9. Definition of Continuity
10. Points of Discontinuity
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| **III****DIFFERENTIATION** | 1. Definition of the Derivative of a Function
2. Basic Rules for Differentiation
3. Basic Power Rule
4. Product Rule
5. Quotient Rule
6. General Power Rule
7. Six Basic Trigonometric Functions
8. Hyperbolic Functions (Optional)
9. Implicit Differentiation
10. Chain Rule
11. Functions which have points of non-differentiability (discontinuities, cusps, vertical tangents)
12. Differentials
13. Theorem stating that differentiability implies continuity
14. Applications
15. Significance of 1st and 2nd Derivatives to graphing
16. Maxima, Minima, and points of Inflection
17. Related Rates
18. Optimization Problems
19. Newton’s Method (Optional)
20. Rolle’s and Mean Value Theorems
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| **IV****INTEGRATION** | 1. Integrations that fall under the following forms:
2. Double u-substitution, such as

, 1. Solving Differential Equations
2. General and particular solutions for differential equations where the derivative is explicitly defined
3. By separation of variables
4. Definite Integrals
5. Fundamental Theorem of Integral Calculus
6. Numerical Methods of Approximating Areas
7. Inscribed and Circumscribed Rectangles (optional)
8. Trapezoidal Rule
9. Simpson’s Rule
10. Area between two curves
11. Application for the definite integral (Do some of the following topics, but not necessarily all)
12. Volumes
13. Length of a Plane Curve
14. Area of the Surface of Revolution
15. Average Value of a Function
16. Physics Applications
17. Applications from the Biological and Social Sciences
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| **V****THEORY**  | The student should be exposed to and required to learn the proofs of certain theorems from Calculus. The following are REQUIRED PROOFS: 1. If , then is a natural number
2. Product Rule
3. If , then
4. The Fundamental Theorem of Integral Calculus
5. If and exists, then is continuous at . (Optional)
6. Quotient Rule (Optional)
7. (Optional)
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| **VI****TOOLS OF TECHNOLOGY**  | 1. The student should use tools of Technology, in conjunction with the topics of this course, so that the student becomes aware of what these tools can do and gains experience in using them.
2. The student should use tools of technology (graphing calculators or computer software) to accomplish the following:
* Find limits graphically and numerically
* Integration and differentiation of functions similar to those found in this course outline
* Solve problems that cannot be readily solved without a tool of technology.
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**References**

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Thomas, George B. and Ross L. Finney. Thomas’ Calculus, Alternate Edition. Boston, Addison Wesley, 2003

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