

Course Title: Calculus III (IAI Code: MTH 903)

Course Description: *IAI Description:* Topics include (but are not limited to) the following: limits and continuity; definition of derivative: rate of change, slope; derivatives of polynomial and rational functions; the chain rule; implicit differentials; approximation by differentials; higher order derivatives; Rolle's Theorem: mean value theorem; applications of the derivative; anti-derivative; the definite integral; the fundamental theorem of calculus; area, volume, other applications of the integral; the calculus of the trigonometric functions; logarithmic and exponential functions; techniques of integration, including numerical methods; indeterminate forms: L'Hospital's rule; improper integrals; sequences and series, convergence tests, Taylor series; functions of more than one variable, partial derivatives; the differential, directional derivatives, gradients; double and triple integrals: evaluation and applications.

Semester Credit Hours: 3-5

Prerequisite: Successful Completion of Calculus II

Course Objectives/Standards:

based on the Illinois Mathematics Standards (IMS) for Teachers

Upon completion of this course a student should be able to:

Knowledge Objectives

- Graph, differentiate and integrate parametric curves. (IMS 2A, 3A, 4B, 5A)
- Graph, differentiate and integrate curves given in polar coordinates, including conic sections. (IMS 2A, 3A, 5A)
- Write equations of lines and planes in space, including equations of tangent planes and equations of normal lines. (IMS 2A, 3A)
- Differentiate and integrate vector functions in two & three dimensions. (IMS 3A, 4B)
- Apply calculus, using vectors, to study motion in space and in other situations. (IMS 2A, 3A, 4B)

- Explain the concept of limits & continuity in functions of several variables. (IMS 3A)
- Find differentials, directional derivatives and gradients of functions of several variables. (3A, 5A)
- Find extrema of functions in two variables, including using Lagrange Multipliers. (IMS 3A, 4B, 5A)
- Simplify indefinite and evaluate definite double integrals. (IMS 3A)
- Use double integrals in applications. (IMS 2A, 3A, 4B, 5A)
- Simplify indefinite and evaluate definite triple integrals, including triple integrals using cylindrical and spherical coordinates. (IMS 3A)
- Use triple integrals in applications. (IMS 2A, 3A, 4B, 5A)

Performance Objectives

- Graph, differentiate and integrate parametric curves. (IMS 2C, 3B, 6C1, 7C8, 8C1, 8C4, 8C5, 8C6)
- Graph, differentiate and integrate curves given in polar coordinates, including conic sections. (IMS 2C, 3B, 6C1, 6D1, 7C8, 8C1, 8C2, 8C5, 8C6)
- Use cylindrical & spherical coordinates to write equations of three dimensional figures. (IMS 2C, 6C2, 6D1, 7C8, 8C6)
- Write equations of lines and planes in space, including equations of tangent planes and equations of normal lines. (IMS 2C, 7C8, 8C5, 8C6)
- Differentiate and integrate vector functions in two & three dimensions. (IMS 2C, 6C1, 7C8, 8C1, 8C5, 8C6)
- Apply calculus, using vectors, to study motion in space and in other situations. (IMS 2C, 6C2, 7C8, 8C1, 8C2, 8C5, 8C6)
- Explain the concept of limits & continuity in functions of several variables. (IMS 2C, 3B, 7C8, 8C4, 8C5, 8C6)
- Find partial derivatives of functions of several variables. (IMS 2C, 3B, 6D1, 7C8, 8C1, 8C4, 8C6)
- Find differentials, directional derivatives and gradients of functions of several variables. (6D1, 7C8, 8C1, 8C5)
- Find extrema of functions in two variables, including using Lagrange Multipliers. (IMS 2C, 6C1, 6D1, 7C8, 8C1, 8C4, 8C5, 8C6)
- Simplify indefinite and evaluate definite double integrals. (IMS 2C, 3B, 6C1, 6D1, 7C8, 8C5, 8C6)
- Use double integrals in applications. (IMS 2C, 3B, 6C1, 6D1, 6D3, 7C8, 8C5, 8C6)
- Simplify indefinite and evaluate definite triple integrals, including triple integrals using cylindrical and spherical coordinates. (IMS 2C, 3B, 6C1, 6D1, 7C8, 8C5, 8C6)
- Use triple integrals in applications. (IMS 2C, 3B, 6C1, 6D1, 6D3, 7C8, 8C5, 8C6)

The following competencies/objectives are strongly recommended for inclusion in Calculus III. However, they are not part of the IAI description for Calculus III.

Knowledge Objectives

- Understand vector fields. (IMS 2A, 3A, 4B)
- Find/evaluate line integrals. (IMS 2A, 3A, 4B)

Performance Objectives

- Understand vector fields. (IMS 2C, 3C, 6D1, 7C8, 8C5, 8C6)
- Find/evaluate line integrals. (IMS 2C, 3B, 6C1, 7C8, 8C5, 8C6)
- Use Green's Theorem. (IMS 8C5, 8C6)

Sample of Acceptable Course Assignments/Assessments/Artifacts
(by Standard and Indicator)

2A

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Written analysis of videos modeling problem solving;
- Reflective writing on problem solving;
- Writing/analyzing multiple solution strategy problem solving;
- Peer tutoring on problem solving strategies

2C

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams that demonstrate the ability to generalize mathematical properties from specific cases/problems and formulate theorems or discover more general situations where such properties apply.

3A

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on reasoning;
- Completion of proofs;
- Peer tutoring on reasoning.

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3B

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on reasoning with technology;
- Completion of proofs;
- Peer tutoring on reasoning with technology.

4B

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on mathematics and how it relates to other disciplines.

5A

- Evaluations of appropriate use of technology on homework problems or class discussions or problem/project presentations or quizzes/exams requiring the use of technology: programming language or graphing calculator or mathematics software or internet resources or power point.

6C1 and 6C2

- Use number sense and proportional reasoning in the solving of calculus problems (finding extrema, points of inflections, asymptotes, max/min problems, related rates, Newton's Method) as evaluated by homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Peer tutoring on number sense and proportional reasoning.

6D1 and 6D2

- Evaluations of appropriate use of algorithms with or without technology to solve problems as evidenced by homework problems or class discussions or problem/project presentations or quizzes/exams OR computer/calculator programming exercise;
- Reflective writing;
- Peer tutoring on use of algorithms with or without technology to solve problems.

6D3

- Evaluations of ability to apply and use numerical integration to approximate results and solve problems as evidenced by homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing.

7A6 and 7B6

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams on logarithmic scale and finding derivatives and integrals of exponential/logarithmic functions including in application problems.

7C8

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams on modeling areas under curve as summation of rectangles and use of slices and shells to visualize volume.

8B3

- Evaluation of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise on finding integrals of relations such as logarithmic, parametric, absolute value and connections of the calculus to the graphs of these relations.

8C1, 8C2, and 8C4

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Completion of proofs involving limits and how they relate to rates of change, distance, area, and volume.

8C5 and 8C6

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Completion of proofs on ALL aspects of calculus: derivatives, integrals, continuity, limits, applications.