The Principles of Calculus
I, II, and III

Course Outline

Rough Draft - 09-29-2021

Contents

Course Outline – Common Features

Common Features

Lecture: three hours per week.

Discussion sections: two hours per week. One is a collaborative learning workshop. One is a directed question and answer period.

Homework: has two parts. The first part consists of self-check problems delivered electronically. The second part consists of careful write ups of the worksheets that have previously undergone guided peer review.

Exams: One midterm and one final.

Video: Video content supplements discussion section content and should be watched prior to discussion section.

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Course Outline

The Principles of Calculus I

Note: This course has already been constructed and is being currently implemented.

- I. Decomposition
- II. Transformation
- III. Rigidity
- IV. Symmetry

Short Description:

The first course in the three course sequence, The Principles of Calculus I is a course on the application of transformation and symmetry to the study of elementary functions. Decomposition, Transformation, Rigidity, and Symmetry are the four themes of the course. Topics include: functions and their graphical representation; operations on and with functions; set builder notation; linear systems; the group of isometries of the plane; scalings of the plane; physical units; trigonometry and its applications; inverse functions; inversion of the y-axis; polynomial and rational functions; rigidity of rational functions; rigidity and intersections of lines and planes; graphical representations of trigonometric functions and sinusoidal functions; trigonometric equations; exponential functions; logarithms; tangency in an algebraic setting.

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Course Outline

The Principles of Calculus II

- V. Finite Approximation
- VI. Local Linear Approximation of Functions

Short Description:

The Principles of Calculus II applies the principle of finite approximation to the study of the local linear approximation of functions. Topics include: finite approximation of planar area, sequences and their limits, analysis of error; continuous limits; continuity; asymptotic behavior; approximating rate of change; the derivative; Newton’s Method; approximation by the tangent line; derivatives of elementary functions; implicit differentiation; related rates; the geometry of particle motion; the mean value theorem; extremal points; the antiderivative; simple first order differential equations.

Course Outline

The Principles of Calculus III

- VII. Local Higher Order Approximation
- VIII. Integration

Short Description:

The Principles of Calculus III uses the higher order approximations of functions as well as the principles of decomposition and integration to study global properties of functions from their local behavior. Topics include: series and their convergence; Taylor's theorem and Taylor series; elementary differential equations of higher degree; the geometry of particle motion in several spatial variables; the fundamental theorems of calculus I and II and their consequences; integration techniques; area, volume, arc length, and surface area integrals in a single real variable; work integrals and planar area.

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Principles of Calculus I

Note: This course has already been constructed and is being currently implemented as the current Math 5.

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• II. Transformation

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• III. Rigidity

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• IV. Symmetry

Principles of Calculus II

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• VI. Local Linear Approximation of Functions

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Principles of Calculus III

• VII. Local Higher Order Approximation

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• VIII. Integration