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Fall 8-31-2024

# OER Textbook Review for Calculus - Openstax Calculus

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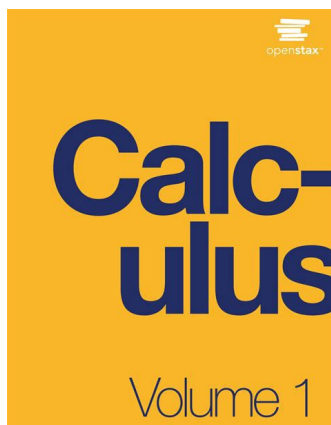
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**Resource:** *Calculus: v1, v2, and v3* by OpenStax

**Reviewer:** Jing Hu, Adjunct Lecturer, Bentley University

**Date of Review:** 08/31/2024

**URL:** OpenStax Calculus

## Comprehensiveness

OpenStax Calculus, a free and open-access calculus textbook, offers a broad and in-depth exploration of calculus, covering essential topics such as limits, derivatives, integrals, and series, as well as more advanced areas like multivariable calculus and differential equations. The textbook provides a thorough foundation in fundamental concepts while also touching on applied aspects of calculus.

The textbook is divided into three volumes to enhance flexibility and efficiency in learning:

- o Volume 1 covers functions, limits, derivatives, and integration.
- o Volume 2 covers integration, differential equations, sequences and series, and parametric equations and polar coordinates.
- o Volume 3 builds on parametric equations and polar coordinates, and further explores vectors, functions of several variables, multiple integration, and second-order differential equations.

## Content Accuracy

This OER textbook presents well-established mathematical principles and provides correct and reliable explanations and proof. Here is the content accuracy in several learning topics.

- (i) *Limits*: Gives the precise definitions of limits, accurately discusses limit laws, and provides clear explanations of one-sided limits and limits at infinity.
- (ii) *Derivatives*: Presents definitions and differentiation rules effectively, including the product rule, quotient rule, and chain rule, supported by well-illustrated examples.

(iii)   *Integration*: Thoroughly explains the fundamental theorem of calculus and applies integration techniques such as substitution, integration by parts, and partial fractions correctly.

(iv)   *Differential Equations*: Covers basic methods for solving ordinary differential equations, including separation of variables and homogeneous equations.

(v)   *Multivariable Calculus*: Explains in detail for understanding concepts like partial derivatives, multiple integrals, and vector calculus.

**Relevance/Longevity**

The textbook connects theoretical concepts to practical scenarios, demonstrating the utility of calculus in various fields like economics, engineering, and the sciences. It includes discussions on numerical methods, computer algebra systems, or developments in applied calculus. The relevance of this OER textbook is reflected in the interactive exercises, problem-solving techniques and visual aids like the graphs, diagram, charts and tables in color.

All three volumes cover timeless concepts that remain central to calculus education. The open-access nature of this textbook ensures that it remains freely available to students and educators, which contributes to its long-term utility and relevance.

**Clarity**

The textbook presents precise definitions for fundamental concepts such as limits, derivatives, and integrals. For better understanding, the textbook summarizes key terms, formulas and concepts at the end of each chapter. Concepts are broken down into manageable steps, enhancing accessibility and comprehension. For example, the explanation of limit laws is systematically structured to facilitate logical progression.

Problems are presented with clear and concise instructions, removing ambiguity and making requirements straightforward. A diverse range of examples effectively illustrates essential concepts, emphasizing key points and demonstrating various applications. Students can visualize function behavior near specific points by graphs, diagrams, charts and more.

Based on my teaching experience, there are two great features in this OER calculus textbook:

- o   Each chapter summarizes key terms, key equations, and key concepts at the end.
- o   There are links to related learning content. Clicking a link takes you directly to the relevant section.

**Consistency**

This OER textbook clearly and logically explained definitions, concepts, theorems and methods in calculus. This calculus textbook features a well-organized structure, introducing topics in a sequence that builds upon previous material. Each chapter transitions smoothly into the next, maintaining a coherent flow throughout.

The examples and exercises are carefully selected to align with the material being covered, ensuring relevance and appropriateness. Proofs and derivations are thorough and follow logically from initial assumptions and prior results, reinforcing the consistency and reliability of the content.

**Modularity**

The modularity of this OER textbook enhances its usability for both teaching and learning. Each chapter focuses on a specific topic or concept, allowing students to concentrate on one area at a time. This structured approach helps students master each concept thoroughly before moving to the next, promoting a more organized learning experience.

Students can easily revisit individual chapters for review or additional practice without needing to sift through unrelated content. This feature is especially beneficial during exam preparation or when revisiting challenging topics.

The answer key for the exercise problems in each chapter stands out from those in typical textbooks. Instead of simply providing answers, it includes graphs as well. This feature is especially useful for helping students grasp concepts like the area under a curve or between two curves in integration. This format in the answer key is helpful for students to better understand the true meaning of the integration.

**Organization/Structure/Flow**

The textbook starts with fundamental concepts and gradually introduces more advanced topics, providing a step-by-step progression that builds a solid foundation. Early chapters cover essential topics such as

limits, derivatives, and basic integrals, which are crucial for understanding more advanced material, like multivariable calculus or differential equations, that are introduced later.

Each chapter begins with clear objectives and goals, outlining what students should understand and achieve by the end. This helps students focus their study efforts and monitor their progress effectively. The textbook integrates explanations with examples and practice problems to reinforce the material. This approach encourages students to apply concepts as they learn, enhancing retention and understanding. Additionally, the textbook includes links throughout the content. For example, links may be found within paragraphs for related material or in key terms that connect to relevant sections within the chapters.

**Interface**

This textbook is a well-organized and accessible resource for mastering calculus due to its user-friendly and intuitive design. Each section and subsection are clearly labeled with headings and subheadings, facilitating easy navigation and quick location of specific topics. This hierarchical structure allows students to find the information they need efficiently.

Visual aids such as graphs, figures, charts and diagrams are well-integrated into the text. They are clearly labeled and positioned to complement the surrounding content, helping to clarify complex ideas and make them more accessible. Key terms, concepts, formulas and theorems are summarized at the end of each chapter with the links connecting to the related sections within chapters.

**Grammatical Errors**

This textbook is a reliable and authoritative resource for learning calculus. It ensures that complex mathematical content is conveyed clearly and accurately. The material is presented in an accessible and understandable manner, with careful attention to grammar that prevents unnecessary confusion. This clarity allows both students and instructors to follow explanations and instructions with ease.

**Cultural Relevance**

This OER textbook exhibits cultural inclusivity, though its primary focus remains on delivering mathematical concepts. The language used throughout the textbook is neutral and inclusive, promoting a very friendly learning environment where students from different backgrounds feel comfortable to learn.

Problem sets and exercises are designed to be universally applicable, avoiding culturally specific scenarios that may not be familiar to all students.

**Conclusion**

OpenStax Calculus, a free and open-access calculus textbook, is a valuable learning material for both students and educators. The textbook provides a solid foundation in calculus and remains an effective and pertinent educational resource.

This OER textbook is more than just a free calculus textbook. The website also offers various resources for both instructors and students. Instructors can access the community hub, which provides various forms of support, including my personal favorite: the WeBWorK Problems for OpenStax Calculus Volume I. This means that both students and instructors not only benefit from a free textbook but also from free online homework assignments. I believe that as more people adopt OpenStax Calculus, the WeBWorK problems for Volumes II and III will be developed in the future. Additionally, the site offers a lot of useful resources for students, such as a student solution manual, reading and notetaking guide, and a student time management guide, and more.

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