

Calculus

MAT-1300

2022 07/01/2022 to 06/30/2023 Modified 04/22/2022

Course Description

Calculus is an advanced high school mathematics course. It builds on principles of Geometry, Algebra, Trigonometry, and other prior mathematics courses to take students into the world of limits, derivatives, special computational techniques such as the Power Rule, and differentiation.

Calculus also explores topics related to sequences, series, and the fundamental theorem of calculus as well as differential equations. This is a course that is an important prerequisite for many educational programs in engineering and science.

Rationale

Students are required more and more to have a higher-level background in mathematics before beginning a program of study for engineering and sciences (including medicine). Calculus gives them this edge on being prepared for the more difficult college level courses. It is a logical follow-up course after Pre-Calculus and Trigonometry.

Prerequisite

Pre-Calculus or Trigonometry

Measurable Learning Outcomes

- A. The student will investigate and explore calculus topics including limits, derivatives, integrals, differentiation, sequences and series.
- B. The student will perform computations using the Power Rule, Product and Quotient Rules, and the Chain Rule.
- C. The student will evaluate limits, rates of change, derivatives and other calculations using proven calculus principles and skills.
- D. The student will investigate a variety of functions including exponential and logarithmic functions.
- E. The student will use derivatives to find velocity, rates of change, slopes of tangent lines, equations of tangent lines, reciprocal functions, and square root functions.
- F. The student will evaluate and graph trigonometric functions, exponential functions, and logarithmic functions.
- G. The student will explore topics related to higher-order derivatives, linear approximation, and curve sketching.
- H. The student will investigate the basics of integration including the fundamental theorem of calculus, antiderivatives, and practical applications in real life.
- I. The student will have the opportunity to explore paradoxes and special sequences in calculus including Zeno's Paradox, Fibonacci's Number, and the Golden Ratio.

Biblical Integration Outcomes

- A. The student will learn about the fascinating universe that God created and how mathematics displays His power and glory through mathematical principles that govern the natural laws of the universe.

B. The student will explore how mathematical principles and ideas such as Fibonacci's Number, Euler's Law, and the Golden Ratio are all synchronous with God's handiwork in plant life, building design and other areas of science and math.

Course Resources

See LUOA's [Systems Requirements](#) for computer specifications necessary to operate LUOA curriculum. Also view [Digital Literacy Requirements](#) for LUOA's expectation of users' digital literacy.

This course makes use of third-party digital resources to enhance the learning experience. LUOA staff and faculty have curated these resources. Students can safely access them to complete coursework. Please ensure that internet browser settings, pop-up blockers, and other filtering tools allow for these resources to be accessed. See Technologies and Resources Used in this Course below for a specific list.

Note: Embedded YouTube videos may be utilized to supplement LUOA curriculum. YouTube videos are the property of the respective content creator, licensed to YouTube for distribution and user access. As a non-profit educational institution, LUOA is able to use YouTube video content under the YouTube Terms of Service. For additional information on copyright, please contact the [Jerry Falwell Library](#).

Materials Required for Purchase

The following materials are required in this course:

- Graphing calculator, or utilize an online version such as Desmos at <https://desmos.com/calculator>

Scripture Attribution

- Grades 7-12: All Scripture quotations, unless otherwise indicated, are from the ESV® Bible (The Holy Bible, English Standard Version®), copyright © 2001 by Crossway, a publishing ministry of Good News Used by permission. All rights reserved. May not copy or download more than 500 consecutive verses of the ESV Bible or more than one half of any book of the ESV Bible."

Technologies and Resources Used in this Course

The following resource(s) are used throughout this course:

- Thinkwell

Policies

Students are accountable for all information in the [Student Handbook \(https://www.liberty.edu/online-academy/wp-content/uploads/2021/11/LUOA-Student-Handbook.pdf\)](https://www.liberty.edu/online-academy/wp-content/uploads/2021/11/LUOA-Student-Handbook.pdf). Below are a few policies that have been highlighted from the Student Handbook.

Course Grading Policies

The student's grades will be determined according to the following grading scale and assignment weights. The final letter grade for the course is determined by a 10-point scale. Assignments are weighted according to a tier system, which can be referenced on the Grades page in Canvas. Each tier is weighted according to the table below. Items that do not affect the student's grade are found in Tier 0.

Grading Scale		Assignment Weights	
A	90-100%	Tier 0	0%
B	80-89%	Tier 1	25%
C	70-79%	Tier 2	35%
D	60-69%	Tier 3	40%
F	0-59%		

In order for students to receive credit for a course, the following conditions have to be met:

- All semester exams and module tests have to be completed.
- All Tier 3 projects or papers have to be completed.
- Fewer than 10 zeros exist in the gradebook for blank submissions in a full credit course and 5 zeros for blank submissions in a semester course.

Types of Assessments

To simplify and clearly identify which policies apply to which assessment, each assessment has been categorized into one of four categories: Lesson, Assignment, Quiz, or Test. Each applicable item on the course Modules page has been designated with an identifier chosen from among these categories. Thus, a Quiz on the American Revolution may be designated by the title, "1.2.W - Quiz: The American Revolution." These identifiers were placed on the Modules page to help students understand which Resubmission and Honor Code policies apply to that assessment (see the Resubmission Policy and Honor Code Policy below for further details).

- **Lesson:** *Any item on the Modules page designated as a "Lesson"*

These include instructional content and sometimes an assessment of that content. Typically, a Lesson will be the day-to-day work that a student completes.

- **Assignment:** *Any item on the Modules page designated as an "Assignment"*

Typical examples of Assignments include, but are not limited to, papers, book reports, projects, labs, and speeches. Assignments are usually something that the student should do his or her best work on the first time.

- **Quiz:** *Any item on the Modules page designated as a "Quiz"*

This usually takes the form of a traditional assessment where the student will answer questions to demonstrate knowledge of the subject. Quizzes cover a smaller amount of material than Tests.

- **Test:** *Any item on the Modules page designated as a "Test"*

This usually takes the form of a traditional assessment where the student will answer questions to demonstrate knowledge of the subject. Tests cover a larger amount of material than Quizzes.

Resubmission Policy

Students are expected to submit their best work on the first submission for every Lesson, Assignment, Quiz, and Test. However, resubmissions may be permitted in the following circumstances:

- **Lesson:** Students are automatically permitted two attempts on a Lesson. Students may freely resubmit for their first two attempts without the need for teacher approval.
- **Assignment:** Students should do their best work the first time on all Assignments. However, any resubmissions must be completed before the student moves more than one module ahead of that Assignment. For example, a student may resubmit an Assignment from Module 3 while in Module 4, but not an Assignment from Modules 1 or 2. High School students may not resubmit an Assignment without expressed written permission from the teacher in a comment.
- **Quiz:** Students may NOT resubmit for an increased grade.

- **Test:** Students may NOT resubmit for an increased grade.

If a student feels that he or she deserves a resubmission on a Lesson, Assignment, Quiz, or Test due to a technical issue such as a computer malfunction, the student should message his or her teacher to make the request.

Honor Code Policy

Every time a student violates the Honor Code, the teacher will submit an Honor Code Incident Report. The Student Support Coordinator will review the incident and allocate the appropriate consequences. Consequences, which are determined by the number of student offenses, are outlined below:

- **Warning:** This ONLY applies to high school Lessons and elementary/middle school Assignments and Lessons. Students should view these actions as learning opportunities.
 - **Lessons:** A zero will be assigned for the question only.
 - **Elementary/Middle School Assignment:** The student must redo his or her work; however, the student may retain his or her original grade.
- **1st Offense:**
 - **Lesson, Quiz, or Test:** The student will receive a 0% on the entire assessment.
 - **Assignment:** The student will either:
 - Receive a 0% on the original assignment
 - Complete the Plagiarism Workshop
 - Retry the assignment for a maximum grade of 80%
- **2nd Offense:** The student will receive a 0% and be placed on academic probation.
- **3rd Offense:** The student will receive a 0% and the Director of Faculty will determine the consequences that should follow, possibly including withdrawal from the course or expulsion from the academy.

Materials Selection Policy

LUOA curates educational materials that are consistent with the school's philosophy; however, the fallen human condition depicted in literature (as in Scripture itself) is not always pleasant. Valuable works sometimes have objectionable or profane elements. Good books provide four (4) recognized values.

- They build godly attitudes and character traits.
- They deepen our social and cultural awareness.
- They strengthen our use of written language.
- They provide a lifelong source of enjoyment and relaxation.

In order to instill these values in students and fulfill the stated objectives of the school, all LUOA students are expected to read and study good books on a regular basis. Recognizing that materials designed for one level may not be appropriate for another, three (3) levels of criteria are applied:

- Elementary materials must contain no objectionable material,
- Objectionable elements in sixth through eighth-grade materials must be limited and must serve a specific educational purpose, and
- Objectionable content may be included in high school materials but must be outweighed by positive literary, curricular, and/or Christian values.

The curriculum department has approved required educational materials for students.

Schedule

Module 1: Introduction and Limits

Week 1: Overview and Review

Week 2: Introduction to Limits

Week 3: More Limits

Module 2: Limits and Derivatives

Week 4: Limits and Instantaneous Velocity

Week 5: Introduction to Derivatives

Week 6: More Derivatives

Module 3: Rules for Computing Derivatives

Week 7: Derivative Rules

Week 8: More Derivative Rules

Week 9: Derivatives of Trigonometric Functions & Quarter 1 Exam

Module 4: Derivatives and Functions

Week 10: Exponential and Logarithmic Functions

Week 11: Implicit Differentiation

Week 12: Position, Velocity and More Differentiation

Module 5: Optimization

Week 13: Optimization Applications

Week 14: More Optimization and Related Rates

Week 15: More Related Rates

Module 6: Graphs and Derivatives

Week 16: Extrema and Concavity

Week 17: Graphing Using the Derivative

Week 18: Asymptotes & Quarter 2 Exam

Module 7: Integration

Week 19: More Asymptotes

Week 20: Antidifferentiation

Week 21: Integrating More Functions

Module 8: Area and Motion

Week 22: Area

Week 23: Antiderivatives and Motion

Week 24: Area between Two Curves

Module 9: Indeterminate Forms and Integrating with y

Week 25: Integrating with Respect to y

Week 26: L'Hôpital's Rule

Week 27: Log Functions & Quarter 3 Exam

Module 10: Derivatives of Inverse Functions

Week 28: Inverse Functions

Week 29: Trigonometric Functions

Week 30: Partial Fractions

Module 11: Integration by Parts and Improper Integrals

Week 31: Integrating by Parts

Week 32: Improper Integrals

Week 33: Average Value and Cross- Sectional Volume

Module 12: Solids of Revolution and Differential Equations

Week 34: Disk and Washer Methods

Week 35: Differential Equations

Week 36: Quarter 4 Exam