MAT121 Calculus I

Fall 2019

General Information

Meeting Time and Place

MAT121A: Monday, Wednesday, and Friday: 9:10 – 10:10 a.m., KOS 127.
MAT121B: Monday, Wednesday, and Friday: 2:10 – 3:10 p.m., KOS 127.

Professor

Dr. Jonathan Senning
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Office Hours

Monday, Wednesday: 3:20 – 4:20 p.m.,
Tuesday: 1:30 – 3:00 p.m., Thursday: 10:00 – 11:30 a.m.,
and by appointment.

Textbook

Calculus: Early Transcendental Functions, 4th Edition, Robert T. Smith and Roland B. Minton, McGraw-Hill, 2012.

You may use a graphing calculator in this course. While we will not usually be using calculators in the classroom, you may find it helpful to have one with you during lecture to explore concepts we are discussing. You will be permitted to use a calculator on exams.

Prerequisite

This course requires a working knowledge of algebra and precalculus concepts such as functions, trigonometry, logarithms, and exponentials. The first chapter of the text provides a very quick review of precalculus concepts designed to highlight key concepts but not to introduce this material for those who have not seen it before. *No previous exposure to calculus is assumed,* although the course is appropriate for students who have had some calculus before.

We offer a calculus recitation on Tuesday evenings for students who would benefit from some additional aid and instruction in the types of mathematical operations needed for our work in calculus. Please see the instructor if you want to know more.

Online Materials

A copy of the course syllabus and homework assignments can be found on the Blackboard server at *https://blackboard.gordon.edu*. The online WeBWorK problems for this class are at *http://webwork.math.gordon.edu/webwork2/MAT121-2019FA*.

Academic Accommodations

Our academic community is committed to providing access to a Gordon education for students with disabilities. A student with a disability who intends to request academic accommodations should follow this procedure:

1. Meet with a staff person from the Academic Success Center (ASC) and provide them with current documentation of the disability;
2. Obtain a Faculty Notification Form from the ASC, listing appropriate accommodations; and
3. Submit this form to professors and discuss those accommodations with them, ideally within the first two weeks of classes.

Some accommodations need more time to arrange so communicating early in the semester is important. For more information consult http://www.gordon.edu/academicaccessibility or email asc@gordon.edu.

Academic Dishonesty

Academic dishonesty is regarded as a major violation of both the academic and spiritual principles of this community and may result in a failing grade or suspension. Academic dishonesty includes plagiarism, (see Plagiarism in Student Handbook), cheating (whether in or out of the classroom), and abuse or misuse of library materials when such abuse or misuse can be related to course requirements.

Course Description

Introduction

The world we live in is not static; *change* is an inherent feature. In diverse areas such as the analysis of moving bodies, the maximization of a company's profits, the behavior of the stock market, the flow of blood through the heart, and the growth of populations, change is *the* fundamental characteristic. The ability to understand change, predict it, and anticipate what its effects will be is perhaps a uniquely human characteristic. The discovery of calculus in the late seventeenth century revolutionized mathematics and subsequently the scientific realm. For the first time a language that allowed change to be described, modeled, and calculated existed and was put to use understanding processes in a variety of areas. Today we live in a world in which changes have accelerated. Studying calculus provides not only a formal language that some will use to describe change, but also, and perhaps more importantly, it provides a framework for understanding change; how it is measured, and the cumulative effects of continually changing processes.

This course introduces the study of the calculus, which can be thought of as a study of continuous functions. Calculus is composed of two main branches, *differential calculus* and *integral calculus*. Differential calculus is primarily concerned with problems involving rates of change of a relationship between two variables, particularly the instantaneous rate of change. We might, for example, examine the velocity of a particle at a particular instant in time. The second branch, integral calculus, studies and quantifies the cumulative effects of change and is usually

associated with problems like the calculation the areas of regions with curved or irregular boundaries. From these problems many additional applications of the techniques of integral calculus have been realized.

An important idea that forms the basis of calculus is the notion of the *limit*. Both differential and integral calculus involve uses of limits and the limiting process. In the seventeenth century the connection between the two branches of calculus was discovered independently by two mathematicians, Sir Isaac Newton and Gottfried Wilhelm Leibniz.

Learning Outcomes

Students successfully completing this course will be able to:

- Understand and discuss the concept of *limit* and compute the limits of many elementary functions.
- Understand and discuss the concept of *rate of change* as computed using the *derivative*, be able to compute derivatives of algebraically and estimate them numerically and graphically, and to solve problems which involve derivatives.
- Understand and use summation (“sigma”) notation and compute Riemann sums.
- Understand and discuss the concept of *integration*, compute *definite integrals* and evaluate simple *indefinite integrals* and understand their relationship to each other through the *Fundamental Theorem of Calculus*.
- Apply the tools of calculus to develop mathematical models from areas such as biology, economics, business, and the physical and social sciences.
- Have a deepened appreciation for how calculus and analytical reasoning allows one to understand various processes observed in our world and to make predictions based on those processes, thus allowing them to make more informed decisions.

Gordon College Core Curriculum

Students successfully completing this course are prepared to meet the following learning outcomes in the College's Core Curriculum:

(2) Students will be able to identify some of the central principles of the creation, as discovered by the natural sciences, mathematics, or computer science.

(7b) Students will select quantitative information that is relevant to an argument, present it in an effective format, and draw accurate conclusions from it.

Procedure and Workload Expectation

Class time will primarily be devoted to presentation and discussion. I encourage you to ask questions during class regarding the material presented and at times I may ask you to perform some work during our class meeting times.

For each semester hour of credit, students should expect to spend a minimum of 2–3 hours per week outside of class in engaged academic time. This time includes reading, writing, studying, completing assignments, lab work, or group projects, among other activities.

Course Requirements

Attendance and Participation

You are expected to attend class and will be responsible for what transpires in class regardless of your attendance. Please avoid arriving late and do not leave during class unless it is an emergency or you have made prior arrangements with me. Each student is allowed six (6) absences during the term for whatever reason. For each absence after the sixth you should expect a four percent (4%) reduction in your final average. If you are aware of classes you will need to miss because of field trips, athletic events, or for personal reasons, plan to include those among your allowed absences. Note that 5% of your final grade is determined by your participation during class. This means you are present and engaged in all classroom activities.

I expect that during class you will not use your cell phone, tablet or laptop for non-class related conversations or activities. These activities prevent you from fully concentrating on our topic and they are often distracting to those around you.

Homework

Your assigned work outside of class will take three forms, explained below.

1. *WeBWorK problems* (**graded instantly**). These on-line problems provide immediate feedback on how well you understand the material we've just covered. You may repeatedly offer answers to each problem until you get the correct answer and only your final score for each set is recorded. These sets are assigned most days and must be completed before their due date and time. *You should complete the WeBWorK problems* ***before*** *working on practice problems or writing solutions to the problem sets.*
2. *Practice problems* from the textbook (**periodically checked**). While these problems are not graded, they will often be collected, checked for completeness, and returned to you. You may ask questions about them at the start of class and during my office hours. *Do not treat these as optional problems;* they are **required**. You are welcome to do additional problems, but at a minimum you should work these along with the WeBWorK problems and the sets of problems you'll be turning in.
3. *Problems sets* (**graded**). Most weeks of the semester you will have a problem set due, usually on Friday. These problems will be graded for *correctness* (your answer is correct), *completeness* (you have shown proper supporting work or justification for your answer), and *clarity* (the solution is well laid out and clear). Homework will be accepted late but the score will be reduced by 10% if turned by by first class meeting after it was due, 25% if turned in by the second class meeting after it was due, and 50% if turned in by the third class meeting. Later homework will not be accepted, although exceptions to this policy may be made by the professor. The following is expected on all problem sets:
    - Use 8.5×11 paper and make sure there are **no ragged edges.**
    - The cover sheet and your work must be stapled together (**no folded corners**).
    - Solutions should presented in an organized, legible manner.
    - Final answers should be clearly marked.
    - **Proper presentation is important.** Pay attention to detail. For example, axes should be drawn using a straightedge and should be correctly labeled.

Homework Collaboration Policy: All assigned problems are tools to help you better understand the theory and to become more proficient with the techniques of this course. *It is essential that you understand the solution to each problem in order to derive the greatest benefit from this* course.

> *WeBWorK:* You are encouraged to attempt these on your own but may consult with others if you get stuck.
>
> *Practice Problems:* You are encouraged to collaborate while working on these so that you, and those you work with, can help each other understand and practice writing complete, clear solutions.
>
> *Problem Sets:* These should be completed independently and you should thoroughly understand any solution you offer to the problems; i.e. the work you turn in on the problem sets should accurately reflect *your own* understanding of the material.

Quizzes

Roughly every two weeks there will be a short quiz over material we've covered up to that point. These will be given at the start of class (so don't be late). Missed quizzes will receive a zero but the lowest quiz grade will be dropped.

Examinations

There will be two hour-long exams scheduled during the term and a comprehensive final exam. Missed exams will receive a zero. See me if you have a conflict with a scheduled exam.

Grading Procedure

Your final average will be computed using the following table:

Component	***Points***	***Component***	***Points***
Participation	5%	Quizzes	10%
WeBWorK Problems	15%	Exam 1	15%
Practice Problems	10%	Exam 2	15%
Problem Sets	15%	Final Exam	15%

The following table shows the correspondence between the final average (using interval notation) and the letter grades that will be assigned.

[100, 97]	A+	(90, 87]	B+	(80. 77]	C+	(70, 67]	D+
(97, 94]	A	(87, 84]	B	(77, 74]	C	(67, 64]	D
(94. 90]	A–	(84, 80]	B–	(74, 70]	C–	(64, 60]	D–

Tentative Schedule

Day	**Date**	**Due**	***Topic* & Practice Problems**
Wednesday	8/28		*Introduction*
Friday	8/30	Math Auto-biography	*0.1 Polynomials and Rational Functions;* *0.3 Inverse Functions*
Monday	9/2	No Class	*Labor Day*
Wednesday	9/4		*0.4 Trigonometric and Inverse Trigonometric Functions* From 0.3: 11, 15, 21, 23, 47–52
Friday	9/6	Prob. Set 1	*0.5 Exponential and Logarithmic Functions* From 0.4: 1, 3, 9, 11, 19, 21, 37, 41, 55, 57, 59, 73
Monday	9/9		*0.6 Transformation of Functions* From 0.5**:** 9–17 (odd), 23, 25, 33, 37, 41, 45, 47, 65, 69
Wednesday	9/11	**Quiz 1**	*1.1 A Brief Preview of Calculus* From 0.6: 23–29 (odd), 41, 55
Friday	9/13	Prob. Set 2	*1.2 The Concept of Limit* From 1.1: 1, 3, 9a,b
Monday	9/16		*1.3 Computation of Limits* From 1.2: 7, 11, 15, 29
Wednesday	9/18		*1.3 Computation of Limits (continued)* From 1.3: 5–15 (odd)
Friday	9/20	Prob. Set 3	*1.4 Continuity and its Consequences* From 1.3: 17–25 (odd), 29, 47
Monday	9/23	**Quiz 2**	*1.5 Limits Involving Infinity; Asymptotes* From 1.4: 3, 5, 15, 19, 29, 37, 39, 53
Wednesday	9/25		*2.1 Tangent Lines and Velocity* From 1.5: 3, 5–15 (odd), 23, 41, 55, 67
Friday	9/27	Prob. Set 4	*2.2 The Derivative* From 2.1: 5, 11, 19, 27, 29, 35, 41
Monday	9/30		*2.3 Computation of Derivatives: The Power Rule* From 2.2: 5, 9, 13–17 (odd), 27, 51
Wednesday	10/2		*2.4 The Product and Quotient Rules* From 2.3: 1–19 (odd), 23, 25, 29, 39, 49

Day	**Date**	**Due**	***Topic* & Practice Problems**
Friday	10/4	Prob. Set 5 **Quiz 3**	*2.5 The Chain Rule* From 2.4: 1–15 (odd), 21, 25, 51
Monday	10/7		*2.5 The Chain Rule (continued)* From 2.5: 5, 9, 13, 15, 31
Wednesday	10/9	**Exam 1**	Covers Sections 1.1–1.5 and 2.1–2.5
Friday	10/11	Prob. Set 6	*2.6 Derivatives of Trigonometric Functions* From 2.5: 17, 27, 33, 35, 41
Monday	10/14		*2.7 Derivatives of Exponential and Logarithmic Functions* From 2.6: 3–11 (odd), 19, 31, 39
Wednesday	10/16	**Quiz 4**	*2.8 Implicit Differentiation and Inverse Trigonometric Functions* From 2.7: 1–17 (odd), 35, 45
Friday	10/18	No Class	*Quad Finals*
Monday	10/21		*2.8 Implicit Differentiation and Inverse Trigonometric Functions (continued)* From 2.8: 1, 5, 7, 11, 19
Wednesday	10/23		*2.10 The Mean Value Theorem* From 2.8: 15, 31, 33, 43
Friday	10/25	Prob. Set 7	*3.1 Linear Approximations and Newton's Method* From 2.10: 3, 5, 7, 33, 39, 43
Monday	10/28		*3.3 Maximum and Minimum Values* From 3.1: 3, 5, 9, 15, 25
Wednesday	10/30	**Quiz 5**	*3.3 Maximum and Minimum Values (continued)* From 3.3: 1–9 (odd), 25–27 (odd)
Friday	11/1	Prob. Set 8	*3.4 Increasing and Decreasing Functions* From 3.3: 11, 29, 31, 53
Monday	11/4		*3.5 Concavity and the Second Derivative Test* From 3.4: 5, 7, 11, 17, 27, 29, 43
Wednesday	11/6		*3.7 Optimization* From 3.5: 5–15 (odd), 37, 41, 51
Friday	11/8	Prob. Set 9	*3.7 Optimization (continued)* From 3.7: 3, 5, 11, 33

Day	**Date**	**Due**	***Topic* & Practice Problems**
Monday	11/11		*3.7 Optimization (continued)* From 3.7: 9, 15, 41
Wednesday	11/13	**Exam 2**	Covers Sections 2.6–2.8, 2.10, and 3.1, 3.3–3.7
Friday	11/15	Prob. Set 10	*3.9 Rates of Change in Economics and the Sciences* From 3.7: 21, 25
Monday	11/18		*4.1 Antiderivatives* From 3.9: 5, 7, 9, 13, 21
Wednesday	11/20		*4.2 Sums and Sigma Notation* From 4.1: 5–25 (odd), 35, 67
Friday	11/22	Prob. Set 11	*4.3 Area & Riemann Sums* From 4.2: 3, 7, 9, 13, 21
Monday	11/25	**Quiz 6**	*4.3 Area & Riemann Sums & 4.4 The Definite Integral* From 4.3: 1b, 3a, 11b
Wednesday–Friday	11/27–12/1	No Class	*Thanksgiving Recess*
Monday	12/2		*4.4 The Definite Integral* From 4.3: 9, 15, 35 (use calculator or web app as needed)
Wednesday	12/4		*4.5 The Fundamental Theorem of Calculus* From 4.4: 11, 15, 39, 51
Friday	12/6	Prob. Set 12	*4.6 Integration by Substitution* From 4.5: 5–15 (odd), 19, 33, 55, 65
Monday	12/9		*Applications of Integration* From 4.6: 31–39 (odd), 45, 49
Wednesday	12/11	Prob. Set 13 **Quiz 7**	*Review* Worksheet Problems
Wednesday	12/18	**Final Exam**	**MAT121A 9:00-11:00 a.m.**
Thursday	12/19	**Final Exam**	**MAT121B 9:00-11:00 a.m.**