

MA 1024DL01 Spring 2025

Calculus IV Syllabus

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1 Contact Information

Name	Email	Office Hours	Section	Lec/Dis Time	Location
Dr. Binan Gu	bgu@wpi.edu	M 1-2 PM; T 10-11 AM R 9-10 AM SL405A	DL01	MTRF 8 - 8:50 AM	Kaven Hall 116
Taorui Wang	twang13@wpi.edu	TBA SL 412	DD01	F 9 - 10 AM	Stratton Hall 313
			DD15	F 10 - 11 AM	Olin Hall 126

2 Course Description

This course provides an introduction to multivariable calculus. Topics covered include: multivariable functions, partial derivatives and gradient, multivariable optimization, double and triple integrals, polar coordinates, other coordinate systems and applications. Recommended background:

1. A **practical** understanding of MA 1021 and MA 1022, i.e., basic differentiation and integration skills;
2. Interpretation of the derivative as a rate of change and as a function.
3. The Taylor series and the vector portion from MA 1023: Taylor and Maclaurin series, dot product, cross product, and their geometric interpretations (e.g., orthogonality, equation of a line/plane).

Although the course will make use of computers, no programming experience is assumed.

3 Textbook

Main textbook: *OpenStax Calculus Volumes 3* – free e-versions: Volume 3: we aim to cover the entirety of Chapters 4 and 5.
Supplementary Textbook:

1. *Calculus by Gilbert Strang*. Free e-book on canvas. We quote A LOT from this brilliant book, even though the language is a little old-fashioned.
2. *Thomas' Calculus : Early Transcendentals 14th Edition*,
J.R. Hass, C.E. Heil, M.D. Weir, P. Bogacki, Pearson ISBN: 9780137559879, 0137559879

4 Course Objectives

This course extends the various **one-dimension** mathematical notions to **multiple dimensions**. We explore the mathematical intricacies arisen from the added dimensions and prepare the fundamentals and methods for advanced undergraduate courses in mathematics, science and engineering.

4.1 Goal for Each Topic

For each topic, your main job is to understand

- Why is this topic introduced and studied?
- What are its fundamental connections to prior knowledge in this area?
- Learn the chronology of the topics introduced in this class, and understand the logic from one topic to the next.

4.2 Main Topics

The primary substance of this course are the following working knowledge:

- Understand multivariable functions, limits, and continuity;
- Become fluent in differentials, chain rule, directional derivatives, and gradients;
- Become fluent in multivariable integrals in Cartesian, cylindrical, and spherical coordinates;
- Improve spatial-thinking skills and become proficient in mathematical reasoning;
- Understand the roles of definition, theorem, and proof.
- Connect to state-of-the-art applications in AI and Machine Learning.
- Draw parallels to existing knowledge on single-variable calculus.

4.3 Goals

4.3.1 Course Goals

Two end goals are measured equally in this class:

1. (Understanding) The ability to recall definitions, provide motivating examples and argue with mathematical logic.
2. (Mechanical) The ability to calculate.

4.3.2 Personal Goals

There are a few personal goals I wish everyone achieves by the end of the class.

1. **Learn how to learn.** This includes
 - (a) Forming good learning habits:
 - i. Consistent contact with the course material, i.e., study a little every day.
 - ii. Work on one problem a day.
 - iii. Read for 10 minutes ahead of the lecture.
 - iv. Read for 10 minutes after the lecture.
 - (b) Eradicating bad learning habits:
 - i. Give up too quickly before using **all** available (permitted) resources, i.e., lecture notes, examples, office hours and your brain.

- ii. Immediately look for solutions online.
 - iii. Procrastinate until the due date.
 - iv. Cram before the exam.
2. Learn about yourself: what are your strengths and weaknesses, academically, and mentally, before, during, and after this class?

5 Course Organization

The class typically meets 5 times per week: 4 lectures on MTRF, and 1 discussion section on F. Students are responsible for all material presented in lecture and discussion. My expectations for these activities are:

5.1 Lectures

The four quality hours we spend together every week are meant to **introduce** the subjects by recalling one-dimensional equivalents and examples. Students are expected to **know of** (i.e. *Lehr*) the introduced topics after every lecture. Mastery comes later after exercises. These lectures are recorded via Echo 360, and these videos can be accessed through the course Canvas page.

5.2 Practice Problems

The majority of your association with this course lies in problem solving outside the classroom. Students are expected to take the intuitions gained from lectures and put them into careful examinations by doing suggested homework exercises (i.e. *Kunst*). Solutions to these problems are neither collected nor graded, but they form the main topics of discussion during the Discussion section. The problem selection is a combination of examples of the types of problems to be found on the exams, along with problems that are more detailed and which enhance learning the topics at a deeper level.

Extra credit problems may be assigned during lecture time. They normally involve filling out the details of a derivation and/or more challenging problems within the context of the course. Grades earned from these problems will be complemented to your overall HW grade (see below), though they will not help one exceed the maximum number of points possible.

5.3 Discussion

Students have an opportunity to sit down and work through the practice problems on a topic with an instructor and have their individual questions addressed. It is through the Discussion that the student can get major questions asked so that after Discussion, the student can continue to work through the practice problems to develop mastery.

In each Discussion session, everyone will solve some of the practice problems posted under Discussion on a clean piece of paper, to be submitted at the end of the Discussion. You will be graded by your attendance and performance in class, each out of 1 point. Discussion performance includes asking good questions, helping your classmates and completing more than 75% of the assigned problem numbers. These points will be added to your HW grade with a 1:1 conversion rate (without exceeding the maximum HW points). See more on extra credits below.

5.4 Canvas

Course materials can be found on the Canvas page. The material is organized by the section number of the topic in the text. In the event that lectures need to be delivered remotely, they will take place through Zoom.

Students are expected to spend an additional **8-12 hours per week** studying outside of class. This includes reading the text, organizing notes, and solving problems.

5.5 Communications

The primary interface for communication with the instructor & course staff will be email, the Canvas course website, office hours and Discussions. All information about the course will be maintained on the course web page in WPI's Canvas system. Check it often.

Check your WPI email **daily**. Students can expect a response to email within 24 hours on weekdays and within 48 hours on weekends.

6 Assignments

There are three different types of assignments for this course.

6.1 Written Homework

6.1.1 Expectations

Written Assignments weigh considerably in this course. Take them seriously. These assignments involve handwritten solutions to mathematical problems from the course textbook and my lecture notes. Written solutions should be **second drafts** that thoroughly demonstrate your thought process, including justifications of steps. These assignments are due approximately once a week, and they can be accessed through the Assignments Module on Canvas.

6.1.2 Collaborations and Citations

Collaborations among classmates are welcome. Every HW submission must declare a list of collaborators at the beginning, though each student is expected to compose his/her own solutions. **Extensive similarities between assignments without collaboration declarations will be considered as plagiarism and will be penalized severely.**

If the solution depends on online sources or textbooks, the student is responsible for citing them with a reference style of your choosing. Uncited solutions, if confirmed, will be considered as plagiarism and will not receive any credit.

6.1.3 Return-and-correct Policy

Each student has **one day** to correct his/her solutions after HW is returned. Resubmissions may be graded without penalty if the initial submission has sufficient effort in solving **every** problem. Poor attempts at the initial submission will receive little credit and no resubmission opportunities.

Every resubmission must address **every query** to be considered valid. The corrections should be written using a different colored pen/pencil, **either in a side column clearly marked for short corrections, or on new sheets of paper for long corrections with proper titles**. We expect your corrections to incur minimal effort for the grader to see.

The initial submission and later corrections are to be submitted as **a single PDF file** via the canvas assignment module.

6.1.4 Grading Policy

Written Homework Assignment **and** Corrections abide by the following hierarchy of consideration:

Type	Submission Qualities/Criteria
Presentation	Quality is neat and easily readable. Ample spacing between each problem.
Completion	Every problem has a committed attempt.
Syntax	Correct use of basic mathematical symbols: = (equal to), $\implies$ (implies), $\lim$ (limit sign before evaluation), $\rightarrow$ (converges), $\int f(x) dx$ (correct variable), etc.
Correctness	Completely correct, clear, & thorough write-up of problem solution, citing rules & theorems where appropriate.

Each assignment will contain two parts. The first part contains technical exercises that train your computational skills such as differentiation and integration. The second part, typically shorter than the first, raises questions that make you think a little more about the “how”s and “why”s. The HW is graded on four problems selected from the two parts, each worth 5 points (1 point per criterion shown above other than Correctness, which is worth 2), making the assignment out of 20. No half points are given.

The instructor and the PLA/Grader reserve the rights to reject HW with poor presentation, careless completion or ineligible format (single pdf) without further review of its content. The first rejection acts as a warning, and its resubmission incurs a 15% penalty; any HW rejection after the first offense automatically receives a score of zero without debate.

6.1.5 Late HW Policy

Any late HW abides by a “15% per day late submission policy” unless a valid excuse is supported with proper documentation. Students requesting HW extensions must arrange **an in-person meeting** with me to explain the situation. Emails directly requesting extensions will not be replied, unless it is a medical/family emergency.

6.2 Labs

Provides instruction on use of software MATLAB and Desmos for Calculus applications. Students registered to labs receive synchronous instruction in the first week introducing the topic and software commands required to execute the scheduled labs. Asynchronous videos assist the student through a systematic process leading to understanding of graphing, algebraic, and Calculus commands. In the next week, lab instructors offer office hours for questions.

There are three lab sessions for D-term: TBA.

6.3 Quizzes

A 10-minute Quiz is given at the end of each week’s Discussion on Friday at the 40th minutes (those requiring accommodations start at 35th). Each quiz covers approximately the same amount of content and has approximately the same level of difficulty. **All quizzes are closed book, closed notes, and no electronic devices are allowed.**

The short quiz is meant to be a conceptual check that contains a few T/F questions and short responses, and no explicit calculations. The T/F always requires a reason or counterexample to justify your judgment, which should motivate you to gain the true ways of scientific inquiry.

6.4 Exams

6.4.1 Format and Dates

Two 50-minute exams are given in lecture. Each exam covers approximately the same amount of content and has approximately the same level of difficulty. **All exams are closed book, closed notes, and no electronic devices are allowed.** The tentative exam dates are **April 10th, 2024 and May 7th, 2024.**

6.4.2 Policy on Makeup Exams

Unless there are extenuating circumstances, no makeup exams are allowed. Students requesting exams to be taken at times other than the proposed dates must provide valid reasons with proper documentation (medical, familial, or religious reasons). A temporary grade of Incomplete is assigned until all makeup exams are finished (typically given during the first week of A-term).

6.5 Extra Credits

This section addresses all extra credit queries. There are two types of extra credits: exceeding and non-exceeding.

Exceeding extra credits are those that may help one's score exceed the maximum score of a particular type of assignment, i.e., earn over 100%. These include

- Bonus questions on exams.
- Bonus HW problems.

Non-exceeding extra credits are those that only complement the score of a particular type of assignment up to its maximum score, i.e., the aggregate score will not exceed 100%. These include

- HW0.
- Discussion attendance and problem completions (1 point each, for each Discussion).

A little perspective: Seven HW sets have a total of 140 points. HW0 may help you fill in 20 missing points; the seven discussions may help you fill in 14 missing points.

7 Grades

Written HW: $35\% = 5\% \times 7$.

Labs: 10%

Quizzes: $15\% = 3\% \times 3 + 6\% \times 1$.

Exams: 40%:

1. [Anti-tanking mechanism] If $\text{Exam 2} \leq \text{Exam 1} - 20$, then equal weight.
2. [Encourages consistency] If $\text{Exam 1} > \text{Exam 2} > \text{Exam 1} - 20$ then 25% (better exam) +15% (worse exam)
3. [Rewards improvement] If $\text{Exam 2} > \text{Exam 1}$ then 30% (better exam) +10% (worse exam)

Tentative Final Grades: A (>90), B(80-89), C(70-79), NR (<70).

Remark. There is no need to ask me to round up your grade as I will consider this option for everyone. Rounding up to a higher letter grade is only possible when the following conditions are simultaneously met: 1) your current numerical grade is at most 1.00 point away (up to two digits past the dot) from a letter grade change, i.e., 89.00-89.99, but not 88.99; 2) your total quiz score is at least 75/100.

8 Special Arrangements

If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible. My office location and office hours are listed above. If you have not already done so, students who believe that they may need accommodations in this class are encouraged to contact the Office of Accessibility Services (OAS) as soon as possible to ensure that these accommodations are implemented in a timely fashion. The OAS is in Unity Hall, (508) 831-4908. Students who need accommodations for exams are required to make the arrangements to take these exams at the Exam Proctoring Center (EPC) on the day of the exam.

9 Additional Policies

9.1 Electronic Policy

All lectures (audio and video) are captured through course capture and can be found on the course Canvas page. **NO** recording of audio or video by students is allowed during lecture or during discussion. Laptops, phones, and tablets should be turned off during the lecture and conference sessions. If you take notes (typing/stylus only) using these devices during lecture, then you should sit somewhere in the room where your screen activity is not distracting to your neighbors.

9.2 Exam Policy

Prior to the start of each exam, you must place all of your belongings (e.g., cell phone, study materials, smart watches, etc.) in your backpack and under your desk, so that no items are visible during the exam. **All exams this term are closed book, closed notes, and no electronic devices are permitted.** Cheating is an extreme offense. Students involved in plagiarism will be reported to the Dean of Students without grace periods and negotiations.

9.3 AI Policy

AI engines such as ChatGPT and DeepSeek have been prevalent in our daily life. One unfortunate use is in providing solutions to Homework Problems with (near) impunity due to the random nature of such engines. Artificial intelligence (AI) language models, such as ChatGPT, and online assignment help tools, such as Chegg®, are examples of online learning support platforms: they cannot be used for course assignments and will never be permitted in this course. Please review the WPI webpage “What is Academic Dishonesty”.

The Instructor and the PLA reserve the rights to withhold the alleged assignment(s) and conduct an oral exam on the material therein to verify that the student is capable of matching the understanding displayed in the solutions.