Marshall University Syllabus

Course Title/Number	**Math 229H: Honors Calculus 1 (CT, WI)**
Semester/Year	Fall 2016
Days/Time	Monday and Wednesday 2:00pm – 2:50pm Tuesday and Thursday 2:00pm – 3:15pm
Location	Weisberg Applied Engineering Center 3119
Instructor	Carl Mummert
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Office	Morrow Library 110
Office Hours	Tuesday and Thursday 8:30am – 10:30am Monday and Wednesday 1:00pm – 1:50pm
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy by going to www.marshall.edu/academic-affairs and clicking on "Marshall University Policies." Or, you can access the policies directly by going to **www.marshall.edu/academic-affairs/policies/** *Policies:* Academic Dishonesty / Excused Absence Policy for Undergraduates / Computing Services Acceptable Use / Inclement Weather / Students with Disabilities / Academic Dismissal / Academic Probation and Suspension / Academic Rights and Responsibilities of Students / Affirmative Action / Sexual Harassment.

Course Description From Catalog

An introduction to calculus and analytic geometry for honors students, emphasizing critical thinking. Limits, derivatives, and integrals of the elementary functions of one variable, including transcendental functions. 5 credit hours.

Prerequisite

Math ACT 27 or permission of the instructor.

About this course

Math 229H is an introductory calculus course. The course teaches the fundamental concepts of calculus – limits, derivatives, and integrals – and their applications. This honors course will also have a strong focus on verbal communication and on the underlying concepts of calculus, in addition to symbolic computation.

This is a honors course, but that does not mean it is a more "theoretical" course. Instead, this course will focus on giving you a deeper understanding of the concepts of calculus.

There is no expectation that you have taken calculus already. If you have taken a calculus course in high school, you will probably find that this class is quite different. Besides a different grading system, the focus will be different than a typical high school calculus course. We will focus on interpreting and communicating the concepts of calculus just as much as we focus on computational skills. This may seem unfamiliar at first, but it will help you master the course material more deeply and develop critical thinking skills that will help you in more advanced classes in all subjects.

Math 229H is designated as a *critical thinking* (CT) course. You will receive 5 hours of CT credit towards your core curriculum. Every section of Math 229 and Math 229H is a CT course.

This section of Math 229H is designated as a *writing intensive* (WI) course. You will receive 5 hours of WI credit towards your core curriculum. Most sections of Math 229 are not WI courses.

The main goal of this course

Mathematics, the study of number, is a core part of a classical education. The main goal of this course is to form part of your liberal arts education at Marshall. The course will help you develop ways of mathematical thinking that will make you a better educated person and help you throughout the rest of your life. My goal as the professor is to contribute to your overall education by providing you with knowledge and skills you need to have a successful personal life and career.

Topics – what does the course include?

Calculus is a collection of techniques for understanding and analyzing *changing quantities*: changing position, changing velocity, changing force, changing density, etc. The topics of this course can be broken into four main parts.

Modeling

Representing real-world situations via tables, graphs, symbolic formulas, and verbal expressions allows us to to analyze these situations mathematically.

Limits

Limits measure the place where an object is projected to be at a particular time, or the value that a function that a is projected to have at a particular point, based on where it is at other times or on its values at other points.

Derivatives

Derivatives measure the *rate of change* of a changing quantity. They have many applications for understanding how changing quantities behave and where their maximum and minimum values occur. Derivatives also allow us to express the behavior of changing functions via *differential equations*.

Integrals

In algebra, we learn that if an object moves with constant speed, then the distance traveled is the speed multiplied by the change in time. Integrals allow us to solve similar problems when the speed is not constant. They also allow us to compute the areas of complicated regions and the mass of objects with non-constant density. Integrals have a central role in probability and statistics, as well.

Requirements – what do you need to have?

Textbook

Calculus: Early Transcendentals, third edition,
by Jon Rogawski and Colin Adams. ISBN 978-1-4641-1488-5.

Computer and Excel access

You must have consistent internet access. You should check MU Online and your official MU email account frequently for announcements. Web homework and practice problems will be given on the site:

http://webwork.marshall.edu

This course will occasionally use Mathematica and Microsoft Excel. This software is available to you on all university computer labs. You will probably find it more convenient if you have Excel on your own computer – student licenses are inexpensive at the University Bookstore. There is no need to purchase Mathematica for this course.

Calculators

You will need to have a non-graphing scientific calculator for the course. Among the calculators that are permitted are the Casio fx-115 series and the Texas Instruments TI-36X series. Inexpensive modern scientific calculators such as these have 2-line displays, and I recommend them over older calculators with one-line displays. I will make the final decision about whether any particular device is allowed during a testing situation.

Graphing calculators, phones, tablets, laptops, smart watches, and cellular or networked devices are not permitted during testing situations. You are welcome to use these devices outside of testing situations, as well as software such as Mathematica and Wolfram Alpha.

Paper

You should bring your calculator, paper, and a pen or pencil to every class meeting. You do not need to bring your textbook to class.

Assignments – what do you have to do?

This course will use a form of *standards based grading*. Sixty percent of your grade will be based on completing a predetermined set of Course Problems. The remainder of the grade will come from team homework and from low-stakes writing.

Course Problems

These are a collection of 23 problems, each of which relates to a particular collection of calculus skills. There are many versions of each problem that cover the same skills at a comparable level of difficulty. The full list of problem descriptions is on page 11 below.

- As shown on the course schedule, there will be seven Problem Opportunity Days. The final exam period is also an opportunity to complete Course Problems.
- On each Problem Opportunity Day, you will be given a set of problems, each of which is a version of a Course Problem. More Course Problems will be given as the semester progresses. In general, Course Problems will begin to appear after they have been discussed in class.
- Course Problems will be graded based on successful completion. There is no partial credit, but I will give feedback on your attempted solutions. To receive credit, each solution must be at what would normally be an "A" level.
- Once you complete a Course Problem successfully, you have credit for it for the rest of the semester, and you do not need to attempt it again. You should choose which problems to solve on each Problem Opportunity Day so that you have credit on as many as possible by the end of the semester.
- If you have credit for all the Course Problems, you must still attend class and complete the other assignments, but you no longer need to attend on Problem Opportunity Days.
- Your grade on the Course Problems will be the percentage of Course Problems for which you have credit at the end of the semester. For example, if you have credit for 20 out of 23 problems, your course problem grade will be 83%. Your course problems grade is one of three components of your final letter grade.

On each Problem Opportunity Day, you can do as few or as many problems as you like. To stay on track, you need to successfully complete an average of 3.5 problems each Problem Opportunity Day. There will be time to attempt more problems than that, so you will have the ability to attempt many problems more than once. You can attempt each problem as many times as you like. There is no penalty for incorrect answers, but you must earn credit on problems to contribute towards your course grade.

Team homework

These assignments will require you to work with a team of other students to provide an in-depth, written analysis of three to four problems. Some of the team homework problems will use Mathematica. There will be six Team Homework assignments during the semester, as shown in the course schedule. Partial credit will be given on team homework assignments. The team homework system in this course is modeled on the one used for calculus at the University of Michigan. Some team homework assignments will take place of several weeks, so that a more complex problem can be approached gradually. These longer assignments will often more prose require writing along with the use of computer software.

Low-stakes writing

These assignments ask you to write a short response to a given question. Their goal is simply for you to think about the question and say something reasonable. The term "low-stakes" means that full credit is given for any response that shows engagement with the question. These problems will be posted on MU Online and answered outside of class.

Online practice problems

Online practice problems will be provided using the WebWork system at `http://webwork.marshall.edu/`. These problems consist of one problem set for each section of the text. Each problem set has its own due date after we discuss the section in class. If you earn credit on 90% of the WebWork problems, I will give you a *credit* of one course problem.

GEAR upload

You will be required to upload one of your team homework assignments to the GEAR system. The university uses these uploads to assess the general education curriculum and the Writing Across the Curriculum program.

Writing component

This is a writing intensive course. The writing component of this course consists of the low-stakes writing, team homework, and many of the Course Problems. I estimate that writing is worth 65% of the course grade.

Final exam

The final exam period will be Thursday, December 14, from 12:45pm to 2:45pm. This is the final Problem Opportunity Day. If you have credit on all the Course Problems, you are not required to come during the final exam period.

Course Schedule

The following schedule is subject to change during the semester. Team Homework due dates and Problem Opportunity Days (POD) are shown.

Week	Dates	Monday	Tuesday	Wednesday	Thursday
1	8/22 – 8/25	1.1, 1.2	1.3, 1.4	Writing	1.5
2	8/29 – 9/1	1.6	2.1	POD 1	2.2
3	9/5 – 9/8	Labor day	2.3	2.4	Team HW 1
4	9/12 – 9/15	POD 2	2.5	2.6	2.7, 2.8
5	9/19 – 9/22	3.1	4.1	3.2	Team HW 2
6	9/26 – 9/29	POD 3	3.3	3.4	3.5
7	10/3 – 10/6	3.6	3.7	3.8	Team HW 3
8	10/10 – 10/13	POD 4	3.9	3.10	3.10
9	10/17 – 10/20	4.2	Writing	4.3	Team HW 4
10	10/24 – 10/27	POD 5	4.4	4.5	4.6
11	10/31 – 11/3	4.7	4.7	4.8	Team HW 5
12	11/7 – 11/10	POD 6	5.1	5.2	5.3
13	11/14 – 11/17	5.4	5.5	5.6	Team HW 6
	11/21 – 11/24	— Thanksgiving break —			
14	11/28 – 12/1	Review	5.7	5.7	5.8
15	12/5 – 12/8	POD 7	2.9	2.9	TBD
16	12/12 – 12/15	Final exam: Thursday Dec. 15 at 12:45pm			

Grading

Your final grade in the course will be a weighted average of your low-stakes writing grade, your average team homework grade, and the percentage of course problems that you complete successfully.

Course Problems	60%
Team homework	35%
Low-stakes writing	5%

The overall letter grade will be assigned on the following scale:

A:	90 – 100	C:	70 – 80
B:	80 – 90	D:	60 – 70

The following table shows the overall course grade for several possible scenarios.

	15	16	17	18	19	20	21	22	23
75%	C	C	C	C	B	B	B	B	A
80%	C	C	C	B	B	B	B	A	A
85%	C	C	C	B	B	B	A	A	A
90%	C	C	B	B	B	B	A	A	A
95%	C	B	B	B	B	A	A	A	A
100%	C	B	B	B	A	A	A	A	A

Overall course grade with given team homework average (y axis) and number of Course Problems (x axis), assuming full credit for low stakes writing.

Attendance policy

I expect you to attend each class, with the same standards for absences you would use for a professional job. I will record attendance each day. If you need to be absent from class, you should contact me promptly – before the absence, except in case of emergency, just as with a professional job. I will excuse absences that are covered by the university's excused absence policy. I may ask for documentation for repeated absences.

Because there are numerous Problem Opportunity Days, and none on its own can lower your grade, there will be no make ups for single, isolated absences on these days. Lengthy or repeated absences, which always require documentation, will be handled on a case by case basis.

Team homework is a group assignment, so one member's absence will not prevent the assignment from being submitted. Because there are numerous team homework assignments, no make up assignments will be given for them. Team members can ordinarily participate with an assignment even if they cannot attend

on the day it is due. If a team member is unable to participate on a particular team assignment due to a lengthy documented absence, that team homework assignment will not be counted toward the student's grade.

In cases of extremely prolonged excused absences, special accommodations will be made. In some cases, a large number of absences may lead me to recommend withdrawal from the course.

Academic honesty policy

Plagiarism of any kind is not permitted. Students who plagiarize on an assignment will receive a zero for that assignment, and the university-wide plagiarism policy will be followed. Repeated or especially serious violations may lead to a failing course grade or suspension from the university.

On team homework assignments, I expect you to work with your group, and you may ask me questions. If you work with anyone else on a problem – another student, a tutor, a parent, etc. – you need to indicate this on the problem, naming the individual.

Team homework assignments are expected to be your team's original work. Copying material from the internet, or asking others on the internet to solve the problems for you, goes against the spirit of the assignment, and will result in strict penalties. You must clearly attribute any sources that were consulted, and you must not plagiarize from other sources. Although it is not likely to be necessary very often, you should use quotation marks for direct quotes just as you would in any other kind of writing.

Other assignments, including low stakes writing and exams, are expected to be your own original work. You may only use aids that are explicitly authorized by the instructor, such as permitted calculators.

Learning outcomes

The table below shows the learning outcomes for the course and the assignments that will be used to practice and assess each outcome.

Learning outcome	How the outcome will be practiced	How the outcome will be assessed
Evaluate limits, derivatives, and integrals symbolically.	Discussions, low-stakes writing, team homework	Course Problems
Approximate limits, derivatives, and definite integrals from tabular and graphical data.	Discussions, low-stakes writing, team homework	Course Problems
State and explain the definitions of limits, derivatives, and integrals; apply these definitions to test properties of these concepts; and produce verbal arguments and examples showing that basic properties hold or do not hold.	Discussions, low-stakes writing, team homework	Course Problems
Apply the techniques of calculus to answer questions about the analytic geometry of functions, including vertical and horizontal asymptotes, tangent lines, local extrema, and global extrema.	Discussions, low-stakes writing, team homework	Course Problems
Explain verbally the meaning of limits, derivatives, and integrals in their own words, both in general terms and in the context of specific problems.	Discussions, low-stakes writing, team homework	Course Problems
Select or construct an appropriate function to model an applied situation for which calculus is applicable, based on a verbal description of the situation.	Discussions, low-stakes writing, team homework	Course Problems
Apply techniques of calculus to solve applied problems from fields such as engineering and the sciences.	Discussions, low-stakes writing, team homework	Course Problems
Interpret symbolic and numerical results in real-world terms, and analyze the validity of their results in a real-world setting.	Discussions, low-stakes writing, team homework	Course Problems
Develop and enhance writing skills and strategies.	Discussions, low-stakes writing, team homework	Course Problems

Course Problems

This section of the syllabus gives a brief description of each of the 23 course problems. Problems marked (WI) require writing at least part of the answer in sentence form.

Modeling and limits

1. (WI) Use graphical, tabular, and symbolic expressions of functions to interpret their behavior verbally. Distinguish between different families of functions.
2. Use graphical, tabular, and symbolic expressions of functions to compute function values, including transformations, compositions, and inverse functions.
3. Set up equations to model linear, quadratic, exponential, and logarithmic functions based on graphical, tabular, and verbal descriptions.
4. Set up the equations of motion for a rotating object such as a Ferris wheel, using trigonometric functions.
5. (WI) Explain the concepts of limits and continuity verbally, both in general terms and in the context of specific situations.
6. Compute algebraic and trigonometric limits using limit laws.
7. (WI) Compute limits at infinity algebraically and using L'Hopital's rule. Interpret your answers in concrete language, using units as appropriate.

Derivatives and applications

8. (WI) Explain the concept of derivatives verbally, both in general and in the context of specific situations.
9. (WI) Use linearization to estimate values of a function from the derivative, and to estimate values of the derivative from the function. Interpret the results in concrete language, using units as appropriate.
10. Approximate derivatives from graphical and tabular representations of functions.
11. Compute derivatives symbolically using the basic derivative rules, the product rule, and the quotient rule.
12. Compute derivatives using the chain rule and using implicit differentiation.
13. (WI) State the intermediate value theorem and the mean value theorem. Apply them to analyze the behavior of specific functions, giving verbal justifications of your analysis.

14. (WI) Use derivatives to reason about the shape of the graph of a function, and use the shape of the graph to reason about derivatives, using both graphical and tabular representations of the function. Explain your results in concrete language, using units as appropriate.

15. (WI) Use the method of related rates to compute derivatives in applied problems. Interpret your results in concrete terms, including units as appropriate.

16. Use the derivatives of a function, along with the first and/or second derivative test, to classify the behavior of a function at critical points and at the ends of the domain.

17. Solve applied optimization problems by:

    - Setting up an appropriate objective function
    - Identifying the domain
    - Using the method of critical points on the interior of the domain
    - Examine the endpoints of the domain, or compute the necessary limits to determine the end behavior of the objective function.

Integrals and applications

18. (WI) Explain the concept and definition of a definite integral, and use the definition to find the area of simple geometrical regions.

19. Use rectangular and trapezoidal approximations to estimate the value of definite integrals.

20. Compute straightforward integrals, both definite and indefinite, by guessing the appropriate antiderivative.

21. Compute definite and indefinite integrals using the substitution method.

22. (WI) Use integration to compute the net change in a function. Interpret your results in concrete terms, using units as appropriate.

23. (WI) Use the integration error formulas to analyze definite integrals, and justify your analysis verbally.