



## MATH 133— ENGINEERING MATHEMATICS I

Fall 2024

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### 1 Land Acknowledgement

We would like to acknowledge that the Saskatoon campus of the University of Saskatchewan is on Treaty Six Territory and the Homeland of the Métis. We pay our respects to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. We would also like to recognize that some of us may be attending this course from other traditional Indigenous lands. We ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.

### 2 Course Description

*(From the Catalog)* An introduction to foundational concepts and tools in calculus, linear algebra, and statistics that are essential to engineering. Topics include basic integration techniques, limits and continuity, derivatives and their applications, matrix operations and linear transformations, linear regression, and graphing data on various scales.

### 3 Prerequisites

Mathematics B30 and C30, or Pre-Calculus 30, or MATH 102.

Students who do not have the required prerequisites at the time of taking this course should not expect supplementary tutoring from the instructor.

## 4 Course Administration

### 4.1 Course participants

Enrolment is restricted to students in the College of Engineering.

### 4.2 Class schedule

The Math 133 class is divided into twelve blocks, numbered from 1 to 12. The class schedule is presented in the table below.

Block Numbers	Lecture Days	Lecture Timings	Lecture Rooms
1,2,5,6,9 and 10	MWF	9:30-10:50 AM	ARTS 143
3,4,7,8,11 and 12	MWF	1:30-2:50 PM	ARTS 143

### 4.3 Lecture delivery

Each week, there will be two 80-minute in-person lectures on Monday and Wednesday, followed by a Zoom lecture on Problem-Solving Session on Friday. For more detailed schedule and classes, see the PDF file *Math 133-Courseplan* uploaded on Canvas.

### 4.4 Course material and page

Students will be provided with the course material including lecture slides. We will use Canvas to post the course material.

### 4.5 Canvas discussion board

The discussion board on our Canvas course page will be used for all inquiries related to the course content and logistics. Questions should be posted there, and the course team will regularly monitor the board.

### 4.6 Email communication

Students are encouraged to consult the discussion board and post general inquiries there to consolidate all pertinent information. If the discussion board does not provide the guidance you need, feel free to contact the course instructor directly. If you are unsure about the appropriate recipient, direct your email to our course coordinator, Zoe Mao, at [zoe.mao@usask.ca](mailto:zoe.mao@usask.ca), and include your instructor in the CC field. When emailing us, it is important to include **MATH 133** in the subject line and **do not** send your email from any address other than a usask.ca address.

## 5 Learning Outcomes

This course is designed to focus on competency-based teaching and assessments. The class learning outcomes (CLOs) are organized into two main modules, each containing five submodules referred to as root learning outcomes (RLOs). The specifics of these CLOs and RLOs are outlined below:

CLO	RLOs
Module 1	RLO 1: Basic Differentiation and Integration
	RLO 2: Limits and Continuity
	RLO 3: Computing Derivatives I
	RLO 4: Computing Derivatives II
	RLO 5: Matrices and Linear Systems I
Module 2	RLO 6: Matrices and Linear Systems II
	RLO 7: Summary Statistics and Linear Regression
	RLO 8: Applications of Derivatives I
	RLO 9: Applications of Derivatives II
	RLO 10: Graphing Data

After a successful completion of the course, students will

### Module 1

- ❖ Be able to interpret the derivative as the slope of a tangent line to a curve, and understand the definite integral as the net area under a curve over an interval. Be able to apply the power rule for differentiation and integration.
- ❖ Understand the concept of a limit and its basic properties. Determine whether a limit exists, and compute it if it does. Understand the notion of continuity, and distinguish between removable and non-removable discontinuities. Find vertical and horizontal asymptotes of functions.
- ❖ Understand the definition of the derivative as the limit of average rate of change approaching instantaneous rate of change. Understand the common interpretations of the derivative as slopes of tangent lines, instantaneous rates of change of a function, and in particular the velocity of an object in rectilinear motion. Be able to compute derivatives using the product, quotient, and chain rules. and compute derivatives of exponential functions.
- ❖ Be able to evaluate derivatives of trigonometric and inverse trigonometric functions. Apply implicit differentiation to evaluate derivatives for implicitly defined functions. Differentiate logarithmic functions, and apply logarithmic differentiation.
- ❖ Be familiar with common terminology involving systems of linear equations, including augmented matrices, elementary row operations, row-echelon form (REF) and reduced row-echelon form (RREF), and Gaussian elimination. Utilize Gaussian elimination to solve systems of linear equations, and be able to determine when a system is consistent or inconsistent. Perform basic matrix operations

(addition, scalar multiplication and matrix multiplication) and solve linear systems (up to 3-by-3) on paper. Find the transpose and (when applicable) the inverse of a given matrix.

## Module 2

- ❖ Understand the definition of a linear transformation and be able to find the standard matrix for a given transformation. Be able to perform rotation, reflection, and stretch/compression linear transformations in  $\mathbb{R}^2$ . Calculate the determinant of a matrix using cofactor expansion and understand the basic properties of the determinant, including its relation to the area of a parallelogram formed by two vectors, as well as invertibility of matrices. Be able to find the characteristic polynomial, eigenvalues, and eigenvectors of a matrix.
- ❖ Be able to compute basic summary statistics (e.g. mean, median, mode, sample variance, and sample standard deviation) of a given set of data. Understand the concept of percentiles and quartiles, and construct box-and-whisker plots of a given set of data. Find the line of best fit for a given set of discrete data using the method of least squares. Obtain estimates using interpolation and extrapolation, and understand the limitations of these estimates. Articulate what we can and cannot conclude about the underlying set of data given its summary statistics. Use a computational tool (such as Matlab or Microsoft Excel) to perform basic statistical computations.
- ❖ Understand the basic connections between the first two derivatives with the extrema and concavity of a given function. Be able to find absolute extrema of a function on a closed interval. Solve optimization problems of one variable. Solve problems involving quantities with related rates of change.
- ❖ Calculate the linearization of simple functions and use it for approximations. Find approximate solutions to equations using Newton's method. Use L'Hospital's rule to evaluate limits of indeterminate forms when appropriate. Be able to recognize a differential equation.
- ❖ Recognize rectilinear, semi-log, and log-log grids, and be able to plot a given set of points on them. Understand the key elements of common graphing procedures in engineering. Determine representative equations from rectilinear, semi-log, and log-log plots, and verify the equation against observed values.

## 6 Course Assessments

### 6.1 Assessment components

The course assessments for Math 133 consist of two main components.

#### 6.1.1 Assignments

This part of the assessments includes:

- a) Math Jumpstart
- b) Möbius Assignments
- c) Lab Assignments

These assignments will collectively contribute 16% towards the final class grade. For more details and the schedule of this component, consult the *Assignments* document uploaded on the Canvas course page.

### 6.1.2 Module tests

There will be two Module Tests, each contributing 42% to the overall class grades. Should a student not meet the passing criteria (as defined in Subsection 7.2) for a module test, they will have an opportunity to pass it with a Top-Up Module Test. If a student has a valid reason for missing a module test, they may take top-up tests. Students are advised to consult the *Module Tests* document on Canvas for comprehensive details on the schedule and policies related to the module and top-up tests.

## 6.2 Makeup tests/assignments policy

Extensions or exemptions will not be granted for Möbius or Lab Assignments. Under our grading scheme, the Module Test (Type B) grade replaces all lower assignment grades in the module. Thus, if you have to miss a formative assessment for any reason, you would have the opportunity to make that up on the corresponding module test. If you do have to miss a module test for a valid reason, you should e-mail our course coordinator to explain your situation at least five days before the Module Test day, or no later than 24 hours after the start of the module test for medical emergencies. If you are granted an exemption for a module test, you will be permitted to write a make-up module test on the day of the corresponding top-up module test. Note that students who write a make-up module test will not have a further top-up test available for that module.

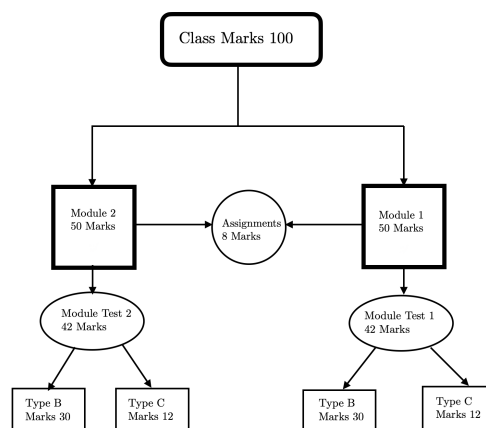
## 6.3 Regrading policy

If you feel that you have been graded incorrectly on a Möbius assignment, you should post your concern on our Canvas discussion board. We would respond there, and this way we keep all the helpful information in one place. And if you feel that you have been unfairly graded on a lab assignment or module test, you should first consult with and carefully verify your work against the posted solutions. If the concern remains, you should complete a re-grade request form (available on Canvas) and e-mail it to our lab coordinator Manuela Golban within one week of the graded assessment being available.

## 7 Grade Evaluation

### 7.1 Grade distribution

The evaluation of student performance in Math 133 will utilize a Competency-Based Assessment (CBA) scheme, featuring Type A, Type B, and Type C problems in assignments and module tests. Students are required to read and understand the specific guidelines on CBA as outlined in the documents titled *Assignments* and *Module Tests*. The diagram provided below offers a visual summary of the course's grading scheme.



## 7.2 Passing criteria

To pass the course, a student **must achieve at least 70% on the Type B portion of the Module Test of each module**. In particular, there is no minimum requirements on the Assignments or Module Test (Type C) credits, nor do they contribute towards passing the course. A few more notes on grade computation:

- All assignments (including Möbius and Lab assignments) in a module are weighted equally in computing the Assignment component score.
- If a student scores higher on Module Test (Type B) than an earlier assignment in the same module, the earlier and lower assignment score is replaced by the later and higher score. For example, if a student scores 80% on the Type B portion of Module Test 2, all of their assignments in Module 2 that were lower than 80% *become* 80% in the computation of their final course grade. This policy is aimed to reward students who show mastery of the material on a module test.
- If a student scores lower than 70% on the Type B portion of the initial module test and then scores at least 70% on the corresponding top-up module test, their Module Test (Type B) score of that module becomes exactly 70%, and they pass the module. And if a student scores lower than 70% on the Type B portion of both the initial module test and the top-up, they would receive a failing score for the module (and hence the course).

If a student meets all of the conditions for passing the course, their final course grade would be that computed according the scheme given in Subsection 7.1. On the other hand, if a student does not meet the passing requirements above, their final course grade would be either 49 or their computed grade from the grading scheme given in in Subsection 7.1, whichever is lower.

## 7.3 A general rubrics

Throughout the course, students' written work (on assignments and module tests) will be graded using the following general rubric:

**10/10 Mastery:** Submitted work is complete, correct, and well communicated. Mastery of the relevant materials are evident.

**9/10 Developing Mastery:** Submitted work is complete, correct, and well communicated barring a small error that does not trivialize the underlying task. Mastery of the relevant materials are evident despite the error.

**7/10 Competence:** Understanding of the relevant materials is evident, but the submitted work requires a non-trivial revision and/or expansion.

**5/10 Developing Competence:** Partial understanding of the relevant materials is evident, but significant gaps remain. Submitted work requires substantial revision and/or expansion.

**3/10 Not Yet Competent:** Submitted work is fragmented, with significant omissions and/or flaws. Not enough information to determine if there's understanding of the material.

**0/10 No Evidence of Competence:** Submitted work is devoid of substance, or no work was submitted at all.

## 8 Academic Integrity

All students in the course are expected to be familiar with and abide by the academic integrity, honesty, and ethical behaviour at University of Saskatchewan (Visit <https://academic-integrity.usask.ca>). Violations of the policy are taken very seriously.

## 9 Use of Generative Artificial Intelligence (GenAI):

We encourage and support the use of Generative AI (GenAI) tools for learning and enhancing your understanding of course material. However, it is important to use these tools ethically and responsibly. The use of GenAI in the course assessments for Math 133 is not permitted. Please be aware that information obtained through GenAI may sometimes be inaccurate or misleading if not carefully verified. As students, mastering your course material is essential to accurately assess and verify such information. Using GenAI for learning is highly encouraged, but using it for dishonest purposes, such as cheating, is easily detectable and violates our academic integrity policies.

## 10 Access and Equity Services (AES):

*E1, Administration Building, University of Saskatchewan, (306) 966 7273*

<https://students.usask.ca/health/centres/access-equity-services.php>

University of Saskatchewan welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, students must follow the policies, procedures and deadlines set by AES. For more information, go to: <https://students.usask.ca/health/centres/access-equity-services.php>.

## 11 Library, Mathematics and Stats Help

Visit the University Library and Learning Hub to find supports with first-year experience, study skills, learning strategies, research, writing, math and statistics. Math and Stats help is located on the first floor of Murray Library, room 144. More information can be found here <https://libguides.usask.ca/math-help>. Students can also attend workshops, access online resources and research guides, book 1-1 appointments or hire a subject tutor through the USask Tutoring Network. Connect with library staff through the AskUs chat service or visit various library locations on campus.

## 12 Teaching, Learning and Student Experience (TLSE)

Teaching, Learning and Student Experience provides developmental and support services and programs to students and the university community. For more information, see the students' website <http://students.usask.ca>.

**This course outline is subject to change. The final version will be provided during the first week of the Fall semester.**