MATH 105 SECTION 1

Calculus

Fall 2023, Session 1

Dates / Synchronous meeting time:	**MoTuTh 10:00—11:15**	**ROOM: IB1047**
Asynchronous Recordings:	Approximately 2—3 (average 2.5) hours per week.	
Academic credit:	4	
Course format:	Recordings, Lectures, Discussions.	

Instructor's Information

Dr. Lin Jiu	Assistant Professor of Mathematics
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Office Hours:	We 10:00—11:30, TuTh 16:00—17:30, or **by appointment**

My main research area is number theory and combinatorics in mathematics. Some other projects involve computations, such as symbolic computation, i.e., computer proofs. Please check my personal website for more information: https://jiulin90.github.io/index.html

What is this course about?

Calculus is one of the foundation courses at DKU, especially for the majors in Division of Natural and Applied Sciences (DNAS). Many tracks required courses list Calculus (and MATH101) as one prerequisite, such as MATH201-Mutivariable Calculus, MATH202-Linear Algebra, PHYS 121 Integrated Science – Physics, SOSC 313 Decision Making Under Uncertainty, etc.

With assumptions that you have already learned basics of calculus, e.g., functions, graphs, etc., this course begins directly with limits, then the two major parts: derivatives and integrations, including all the definitions, properties, methods, and applications.

What background knowledge do I need before taking this course?

You should be familiar with basic functions, e.g., polynomials, rational functions, root functions, trigonometric functions, exponential and logarithmic functions, together with their basic properties, such as graphs, inverses, etc. Also, you should have seen some basic formulas and examples of derivatives and integration.

What will I learn in this course?

1. Limit and Continuity
   - Understand the definition of limits, including at a point and infinity, as well as left and right limits.
   - Calculate limits by choosing the right method, e.g., factorization, conjugates, or by choosing the proper theorem, e.g., Squeeze Theorem, L'Hospital's Rule.
   - Understand the definition of continuity of a function.

- Analyze the continuity of piecewise functions.
- Determine when a function has (vertical, horizontal, and slant) asymptotes, and find them.
2. Derivatives
   - State the definition of definition of the derivative, and its geometric interpretation.
   - Calculate the tangent and normal line to the graph of a function at a point.
   - Understand the derivative as a function and high-order derivatives.
   - Calculate derivatives by applying
     i. the table of derivatives of elementary functions,
     ii. the differentiation rules,
     iii. inverse and implicit differentiation method,
     iv. and the logarithmic method
3. Applications of Derivatives
   - Understand the definition of maximum and minimum values, critical numbers, inflection points of a function.
   - Apply the proper theorem, e.g., closed interval method, 1st and 2nd derivative tests, increasing/decreasing test, to analyze a given function's maximum and minimum.
   - Understand the definition of concavity and analyze the concavity of a function.
   - Sketch the graph of an elementary function
   - Apply the Mean Value Theorem to prove/show properties of a function.
   - Apply the linear approximation formula to calculate approximate values.
   - Analyze and solve practical optimization problems.
   - Analyze and solve related rates problems.
   - Apply the L'Hospital's Rule to compute the limit.
4. Integration
   - Understand the definition of antiderivatives and check the table of antiderivatives.
   - Compute indefinite integrals by the table of antiderivatives.
   - Understand the definition of the definite integral.
   - Apply the fundamental theorem of calculus, to compute derivatives, to evaluate definite integrals, and, combining with L'Hospital's Rule, to evaluate certain limits.
   - Analyze and evaluate the integrations, by choosing the right method:
     i. Substitution
     ii. Integration by parts
     iii. Trigonometric substitution and integration
     iv. Partial fraction decomposition
   - Understand two types of improper integrals.
   - Determine whether an improper integral is convergent or divergent by, e.g., direct calculation, comparison theorem.
   - Evaluate complicated integrals with all the types and methods mixed.
5. Identify parametric curves and parametric basic curves into parametric equations. Moreover, the calculus problems on parametric equations, as:

- Find certain points on the parametric curve;
- Compute the tangents, tangent lines, and normal lines;
- Compute the second derivatives and determine the concavity of the curve;
- Compute the area under the parametric curve.
6. Understand the definition of differential equations, including solutions, initial condition, and initial problems. Also,
    - Given the general solution to a differential equation, verify that the given form is the solution;
    - Given the general solution and an initial condition, find the special solution to the initial problem
    - Solve two basic first order differential equations:
        i. The separable equation
        ii. The linear equation
    - Understand the basic models of exponential grows, population models (natural growth and logistic)

What will I do in this course?

➢ During the weekend BEFORE each week, there will be about 2.5-3 hours pre-recordings uploaded to Sakai. Detailed instructions will be given on which one(s) need(s) to be watched BEFORE lectures. You should watch them in order to follow the lectures.
➢ You should attend scheduled lectures. In particular,
    ✓ On Monday and Tuesday lectures, after reviewing basics given in the recordings, we focus on more delicate examples; concepts that require discussions, etc.
    ✓ Wednesday's lecture is replaced by office hours, due to the limitations of lecture hours.
    ✓ Thursdays' lecture is used as recitation and test slot. For Week 1, 3, 5, and 7, we will work in groups to solve the most problematic questions.
➢ **You MUST attend the three tests and the final exam**.
➢ There is no homework assignment to be turned in; nor quizzed during the lecture time.
➢ According to topics, exercises/practice problems will be assigned via WeBWorK
➢ Office hours, tutors from Academic Resource Center (see below on campus resources) will provide help on any questions.

What required texts, materials, and equipment will I need?
Free textbooks: (both uploaded to Sakai)
1. Calculus, Volume I, by OpenSTAX. https://openstax.org/details/books/calculus-volume-1
2. Calculus, Volume II, by OpenSTAX. https://openstax.org/details/books/calculus-volume-2

What optional texts or resources might be helpful?
1. Calculus: Early Transcendentals 8th Edition, James Stewart.
2. Single Variable Calculus: Early Transcendentals, James Stewart

How will my grade be determined?

Test I	20%	Test I: Aug. 31st. Coverage: Week 1 + Week 2's recordings
Test II	20%	Test II: Sept. 14th. Coverage: Week2 + Week 3
Test III	20%	Test III: Sept. 28th. Coverage: Week4 + Week 5
Final Exam	35%	October 17th, 15:30—18:30. Coverage: EVERYTHING.
Formula Sheets	5%	See the description below

Tests: There are three tests on Thursdays of Weeks 2, 4, and 6. Each is worth 20%.
Final Exam: October 17th, 2023, IB 1047. 15:30—18:30. 35%
Formula Sheet: For **each test**, you are allowed to bring **ONE A4 size formula sheet (double sided)** and for the **final exam**, you are allowed to bring **TWO pieces**; When turning in your answer sheets, formula sheet(s) should also be included, and each piece will be given 1%.

A+= 98% - 100% **A** = 93% - 97.99%; **A-** = 90% - 92.99%;
B+ = 87% - 89.99%; **B** = 83% - 86.99%; **B-** = 80% - 82.99%;
C+ = 77% - 79.99%; **C** = 73% - 76.99%; **C-** = 70% - 72.99%;
D+ = 67% - 69.99%; **D** = 63% - 66.99%; **D-** = 60% - 62.99%;
F = 59.99% and below
As you can see, the final percentage will be rounded DOWN to the closest integer.

Your course grade will not be lower than your final exam percentage. For example, if you obtained an A in the final exam; but overall course calculation, from the table above, shows an A-, you will still receive an A, not an A-.

Your grades will NOT be curved.

What are the course policies?

In case of documented illness or family emergency or documented University sponsored trips, you may miss the test, but the supporting documentation must be submitted to the instructor in advance. **With the document, your missing midterm score can be counted as the same as your final**. Do remember: let me know **BEFORE** the exam. An unexcused absence from any exam will be counted as a zero.

Academic Integrity:
As a student, you should abide by the academic honesty standard of Duke Kunshan University. The DKU Community Standard states: "Duke Kunshan University is a community comprised of individuals from diverse cultures and backgrounds. We are dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Members of this community commit to reflecting upon and upholding these principles in all academic and non-academic endeavors, and to

protecting and promoting a culture of integrity and trust." For all graded work, students should pledge that they have neither given nor received any unacknowledged aid.

Please also include an indication of your typical penalties for an academic integrity violation (such as resubmitting for a reduced grade, 0 on the problem or the assignment, etc.). While the actual penalty might depend on the details of the specific situation, including some indication will help students understand that DKU takes academic integrity seriously. Please also be clear about your policies regarding the use of any online resources, including language translation tools, problem-solving tools, **artificial intelligence**, etc.

Academic Policy & Procedures:
You are responsible for knowing and adhering to academic policy and procedures as published in the University Bulletin and Student Handbook. Please note, an incident of behavioral infraction or academic dishonesty (cheating on a test, plagiarizing, **unauthorized use of online tools**, etc.) will result in immediate action from me, in consultation with university administration (e.g., Dean or Associate Dean of Undergraduate Studies, Student Conduct, Academic Advising). Please visit the Undergraduate Studies website for additional guidance related to academic policy and procedures. Academic integrity is everyone's responsibility.

Academic Disruptive Behavior and Community Standard:
Please avoid all forms of disruptive behavior, including but not limited to: verbal or physical threats, repeated obscenities, unreasonable interference with class discussion, making/receiving personal phone calls, text messages or pages during class, excessive tardiness, leaving and entering class frequently without notice of illness or other extenuating circumstances, and persisting in disruptive personal conversations with other class members. Please turn off phones, pagers, etc. during class unless instructed otherwise. Laptop computers may be used for class activities allowed by the instructor during synchronous sessions. If you choose not to adhere to these standards, I will take action in consultation with university administration (e.g., Dean of Undergraduate Studies, Student Conduct, Academic Advising).

Academic Accommodations:
Duke Kunshan University makes reasonable academic accommodations for qualified students with disabilities. All undergraduate accommodations must be approved through the Student Accommodation Services. Students requesting accommodation for this course should forward their official accommodation letter to the instructor and ask to schedule a time to meet and discuss the implementation of their accommodation(s). It is the student's responsibility to meet, discuss, and provide an electronic copy of the Instructor Accommodation Letter to each instructor. Accommodation will not be granted retroactively. Accommodations for test, quiz, or exam taking must be arranged with the professor at least a week before the date of the quiz, test, or exam, including finals.

What campus resources can help me during this course?

Academic Resource Center

The Academic Resource Center provides tutoring services, and there will be tutors especially for our MATH105 course: https://www.dukekunshan.edu.cn/academics-advising/tutoring-service/

Academic Advising and Student Support

Please consult with me about appropriate course preparation and readiness strategies, as needed. Consult your academic advisors on course performance (i.e., poor grades) and academic decisions (e.g., course changes, incompletes, withdrawals) to ensure you stay on track with degree and graduation requirements. In addition to advisors, staff in the Academic Resource Center can provide recommendations on academic success strategies (e.g., tutoring, coaching, student learning preferences). Please visit the Office of Undergraduate Advising website for additional information related to academic advising and student support services.

Writing and Language Studio

For additional help with academic writing—and more generally with language learning—you are welcome to make an appointment with the Writing and Language Studio (WLS). You can register for an account, make an appointment, and learn more about WLS services, policies, and events on the WLS website. You can also find writing and language learning resources on the Writing & Language Studio Sakai site.

IT Support

If you are experiencing technical difficulties, please contact IT:

- China-based faculty/staff/students 400-816-7100, (+86) 0512- 3665-7100
- US-based faculty/staff/students (+1) 919-660-1810
- International-based faculty/staff/students can use either telephone option (recommend using tools like Skype calling)
- Live Chat: https://oit.duke.edu/help
- Email: service-desk@dukekunshan.edu.cn

What is the expected course schedule?

We will cover most of the following materials from the textbook (*Tentatively, may up to some perturbation*).

Week 1 (Aug. 21--24)	• Syllabus • Limits (1.2.2, 1.2.3). • Continuity (1.2.4).

	● **Asymptotes (1.4.6).**
Week 2 **(Aug. 28—31)**	● Derivatives and Differentiation Rules (1.3.1 - 1.3.4, including essential formulas from 1.3.5 and 1.3.9). ● Chain Rule (1.3.6). ● Derivatives of Inverse Functions (1.3.7). ● Implicit Differentiation (1.3.8). ● Related Rates (1.4.1). **Test I: Aug. 31st. Coverage: Week 1 + Week 2's recordings**
Week 3 **(Sept. 4--7)**	● Linear Approximations (1.4.2). ● Maxima and Minima (1.4.3). ● Mean Value Theorem (1.4.4). ● Derivatives and the Shape of a Graph (1.4.5). ● Optimization (1.4.7)
Week 4 **(Sept. 11--14)**	● L'Hospital's Rule (1.4.8). ● Antiderivatives (1.4.10). ● Integration includes the Fundamental Theorem of Calculus (1.5.3) and the Net Change Theorem (1.5.4). ● Integrals Involving Exponential and Logarithmic Function (1.5.6). ● Integrals Resulting in Inverse Trigonometric Functions (1.5.7). ● Substitution (1.5.5). **Test II: Sept. 14th. Coverage: Week2 + Week 3**
Week 5 **(Sept. 18--21)**	● Integration By Parts (2.3.1). ● Trigonometric Integrals (2.3.2). ● Trigonometric Substitution (2.3.3). ● Partial Fractions (2.3.4).

	Sept. 21st: Week 7's topics survey deadline
Week 6 **(Sept. 25--28)**	● Other Strategies (2.3.5) ● Improper Integrals (2.3.7). **Test III: Sept. 28th. Coverage: Week4 + Week 5**
Week 7 **(Oct. 9--12)**	● Parametric Equations (2.7.1, 2.7.2) ● Differential Equations (2.4.1, 2.4.2, 2.4.3, 2.4.5) ● Review

Final Exam: October 17th, 2023, 15:30—18:30 @ IB 2071