

Math 4301.002: Mathematical Analysis I

Course section: MATH4301.002, Tuesday & Thursday: 8:30am-9:45am ATC 1.305

Instructor: Dr. Viswanath Ramakrishna

Office: Founders Building 2.408C

Office hours: TR 4:00pm – 5:00pm, or by appointment

E-mail: vish@utdallas.edu

Phone: (972) 883-6873

Textbook and Materials

Required Text:

Jerrold E. Marsden & Michael J. Hoffman, *Elementary Classical Analysis*, 2nd ed, W. H. Freeman and Company, New York

Additional Recommended Textbooks:

- *Introduction to Mathematical Analysis* edited by Wieslaw Krawcewicz, Lecture Notes published on the course website.
- Walter Rudin, *Principles of Mathematical Analysis*, 3rd ed., McGraw Hill
- Kenneth Ross, *Elementary Analysis: Theory of Calculus*, 3rd ed., Springer
- Serge Lang, *Undergraduate Analysis*, 2nd.ed, Springer

Prerequisites

MATH 2451 and MATH 3310

Optional Problem Session

We will conduct a weekly, but optional, problem session every Friday for approximately an hour in FO 1.502, starting September 2nd, from 4 - 5pm. Though the session is optional, students in the past have found it quite beneficial.

Course description

Course Catalog Description: Sets, real number system, metric spaces, real functions of several variables. Riemann-Stieltjes integration and other selected topics.

Course Content: The course will cover the following chapters from the textbook

1. **Introduction:** *Sets and Functions:* Sets and operations on sets, formal statements, connectives and logical statements, tautologies, quantifiers, rules and true-false tables; Relations and functions: properties of a relation, equivalence relations, function as an example of a relation, injective, surjective and bijective functions, images and inverse images under a function; Cardinality and countable sets.

- 2. The Real Line and Euclidean Space:** Ordered Fields and the Number System; Completeness and Real Number System; Least Upper Bound; Cauchy Sequences; Cluster Points; \liminf and \limsup ; Euclidean Space; Norms, Inner Products, and Metrics; The Complex Numbers.
- 3. Topology of Euclidean Space:** Open Sets, Interior of a Set; Closed Sets; Accumulation Points; Closure of a Set; Boundary of a Set; Sequences; Completeness; Series of Real Numbers and Vectors.
- 4. Compact and Connected Sets:** Compactness; The Heine-Borel Theorem; Nested Set Property; Path-Connected Sets; Connected Sets.
- 5. Continuous Mappings:** Continuity, Images of Compact and Connected Sets; Operations on Continuous Mappings; The Boundedness of Continuous Functions on Compact Sets; The Intermediate Value Theorem; Uniform Continuity; Differentiation of Functions of One Variable; Integration of Functions of One Variable
- 6. Uniform Convergence:** Pointwise and Uniform Convergence; The Weierstrass M Test; Integration and Differentiation of Series; The Elementary Functions; The Space of Continuous Functions; The Arzela-Ascoli Theorem; The Contracting Mapping Principle and Its Applications; The Stone-Weierstrass Theorem; The Dirichlet and Abel Tests; Power Series and Cesaro and Abel Summability.

These topics are optional: Fourier Series, Hilbert and Banach Spaces: normed spaces and Banach spaces, product of normed spaces, examples of normed spaces and Banach spaces. Linear operators in Banach Spaces, invertibility of linear operators.

Student Learning Objectives

1. Students will be able to use the laws of logic and basic set theory to present formal mathematical arguments.
 - Given properties of a function or a set, students will be able to identify additional properties and present formal argument to justify their claims.
 - Students will learn direct proofs, contra-positive proofs, proofs by contradictions and proofs by induction.
2. Students will be able to learn formal definitions of analytical and topological concepts used in Mathematical Analysis and will be able to apply the most important theorems in Calculus.
 - Given definition of a metric space, students will be able to identify and apply properties of this space, including such concepts as: completeness, compactness, connectedness, continuity of specific function.
 - Students will be able to apply all the main theorems of single-variable calculus: chain rule, Darboux Lemma, l'Hôpital's rule, Leibnitz formula, Taylor Formula, Fundamental Theorem of Calculus
3. Students will learn definitions and the main results concerning pointwise and uniform convergence of sequences and series of functions
 - Students will be able to apply specific tests for uniform convergence to deal with effectively with convergence of sequences and series of functions such as for instance: the Weierstrass M Test, the Cauchy criterion or the Dirichlet and Abel Tests.
 - Students will learn basic results concerning the Space of Continuous (Arzela-Ascoli Theorem, Stone-Weierstrass Theorem) and their most common applications in Mathematical Analysis.

Course Policy

Assignments: Homework assignments will be given, collected and graded. All the assignments should be completed independently by the students. Each assignment is due within one week unless otherwise indicated in the assignment. Late assignments will NOT be accepted unless extreme circumstances accepted by the instructor arise. Students are strongly encouraged to work more than class assignments. The selected assignments are intended to supply adequate practice for mastery of the concepts presented. You should challenge yourself by attempting problems which are not part of the assigned problems.

Attendance is essential in MATH 4301.

Exams: There will be three examinations (Exam I, Exam II and Exam III). Exams are closed-book tests and students are required to take them at the announced time unless extreme circumstances, acceptable to the instructor, arise. Missed exams and assignments are a zero. Students are expected to inform the instructor of suspected honor code violations. Show all details of your work for each problem you solve during exams (unsupported answers will receive little or no credit). Graded exams will be returned to you as soon as possible. Any document not picked up by the end of finals week will be destroyed. The last exam will not be returned to students but held for review for one year.

Makeup Policy: In general makeups will be allowed *only* if there is a valid reason which is supported by official documentation. Examples of valid documentation are **i)** Doctors' notes; **ii)** Letter from employer (in case there is required work related travel, which conflicts with the day of an examination); **iii)** Travel documents (e.g., when a dire family related emergency travel conflicts with the day of an examination). Furthermore, *the onus* is on the student to intimate to me in a timely fashion (in particular, before the scheduled test), the possibility of having to miss the scheduled assignment.

- However, note that all such documentations will be rendered *null and void*, if there is any evidence that the student was, in fact, in a position to take the examination/HW at the originally scheduled time. Thus, for instance, a doctor's note advising rest on the date of an examination for this course will be rendered *null and void*, if there is any evidence that the student was, in fact, in a position to take the examination/HW at the originally scheduled time. Thus, for instance, a doctor's note advising rest on the date of an examination for this course will be considered null and void, if the student was known to have taken an examination for a different course on the same day.
- The makeup HW/examination must be taken at the earliest opportunity convenient to *the instructor*, once the reason for missing the scheduled examination is no longer in force.
- The makeup HW/examination *cannot* be guaranteed to be at the same level of difficulty as the originally examination which was missed.
- Failure to observe any of the above procedures will result in a score of *zero* being assigned for the quiz, HW, examination in question.

Two exams (Exam I, Exam II, Exam III): 25% each

Homework assignments: 25%

Grade Scale

[97.6, 100] $\rightarrow A+$	[93.3, 97.6) $\rightarrow A$	[90, 93.3) $\rightarrow A-$
[86.6, 90) $\rightarrow B+$	[83.3, 86.6) $\rightarrow B$	[80, 83.3) $\rightarrow B-$
[76.6, 80) $\rightarrow C+$	[73.3, 76.6) $\rightarrow C$	[70, 73.3) $\rightarrow C-$
[66.6, 70) $\rightarrow D+$	[63.3, 66.6) $\rightarrow D$	[60, 63.3) $\rightarrow D-$
[0, 60) $\rightarrow F$		

Important Dates

Monday, August 22, 2016: Classes begin
Monday, September 5, 2016: University closed, Labor Day
Wednesday, September 7, 2016: Last day to drop a class without a "W"
Tuesday, October 5, 2016: **Exam I** (in class)
Thursday, October 27, 2016: Last day to drop a class with a "WL"
Thursday, November 3, 2016: **Exam II** (in class)
Thursday, November 24 – Saturday, November 26, Thanksgiving holidays
Tuesday, December 6, 2016: **Exam III** (in class)

These descriptions and timeliness are subject to change at the discretion of the Instructor.

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus. Please go to <http://go.utdallas.edu/syllabus-policies> for these policies.

The University's concealed handgun policy is posted on the campus carry website:
<https://www.utdallas.edu/campuscarry/>

Sharing Confidential Information

Students considering sharing personal information in email, in person, or within assignments or exams should be aware that faculty members and teaching/research assistants are required by UT Dallas policy to report information about sexual misconduct to the UT Dallas Title IX Coordinator. Per university policy, faculty have been informed that they must identify the student to the UT Dallas Title IX Coordinator. Students who wish to have confidential discussions of incidents related to sexual harassment or sexual misconduct should contact the Student Counseling Center (972-883-2527 or after hours 972-UTD-TALK or 972-883-8255), the Women's Center (972-883-8255), a health care provider in the Student Health Center (972-883-2747), the clergyperson (or other legally recognized religious advisor) of their choice, or an off-campus resource (i.e., rape crisis center, doctor, psychologist). Students who are sexually assaulted, harassed, or victims of sexual misconduct, domestic violence, or stalking, are encouraged to directly report these incidents to the UT Dallas Police Department at 972-883-2222 or to the Title IX Coordinator at 972-883-2218. Additional information and resources may be found at <http://www.utdallas.edu/oiec/title-ix/resources>.

Technical Support

If you experience any issues with your UT Dallas account, contact the UT Dallas Office of Information Technology Help Desk: assist@utdallas.edu or call 972-883-2911.

UT Dallas provides eLearning technical support 24 hours a day/7 days a week. The services include a toll free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service. Please use this link to access the UTD eLearning Helpdesk:
<http://www.utdallas.edu/elearning/eLearningHelpdesk.html>.

Field Trip Policies, Off-Campus Instruction and Course Activities

Off-campus, out-of-state, foreign instruction/travel, and course-related field trip activities are subject to state law and University policies and procedures regarding travel and risk-related activities.

Detailed information regarding this policy, in accordance to Texas Education Code, Section 51.950, can be accessed at the UT Dallas Policy Navigator, <http://policy.utdallas.edu/utdbp3023>, and at

<http://www.utdallas.edu/administration/insurance/travel>. Additional information is available from the office of the school dean.

Student Conduct and Discipline

The University of Texas System (Regents' Rule 50101) and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UT Dallas online catalogs (<http://catalog.utdallas.edu>).

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the Student Code of Conduct, UTDSP5003 (<http://policy.utdallas.edu/utdsp5003>). Copies of these rules and regulations are available to students in the Office of Community Standards and Conduct, where staff members are available to assist students in interpreting the rules and regulations (SSB 4.400, 972-883-6391) and online at <https://www.utdallas.edu/conduct/>.

A student at the University neither loses their rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating its standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrates a high standard of individual honor in his or her scholastic work.

Academic Dishonesty: Academic dishonesty can occur in relation to any type of work submitted for academic credit or as a requirement for a class. It can include individual work or a group project. Academic dishonesty includes plagiarism, cheating, fabrication, and collaboration/collusion. In order to avoid academic dishonesty, it is important for students to fully understand the expectations of their professors. This is best accomplished through asking clarifying questions if an individual does not completely understand the requirements of an assignment.

Additional information related to academic dishonesty and tips on how to avoid dishonesty may be found here: <https://www.utdallas.edu/conduct/dishonesty/>.

Copyright Notice

It is the policy of the University of Texas at Dallas to adhere to the requirements of the United States Copyright Law of 1976, as amended, (Title 17, United States Code), including ensuring that the restrictions that apply to the reproduction of software are adhered to and that the bounds of copying permissible under the fair use doctrine are not exceeded. Copying, displaying, reproducing, or distributing copyrighted material may infringe upon the copyright owner's rights. Unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing, may subject students to appropriate disciplinary action as well as civil and criminal penalties. Usage of such material is only appropriate when that usage constitutes "fair use" under the Copyright Act. For more information about the fair use exemption, see <http://copyright.lib.utexas.edu/copypol12.html>. As a UT Dallas student, you are required to follow UT Dallas' copyright policy (UTDPP1043 at <http://policy.utdallas.edu/utdpp1043>) and the UT System's policy, UTS107 at <http://www.utsystem.edu/board-of-regents/policy-library/policies/uts107-use-copyrighted-materials>.

Email Use

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. All official student email correspondence will be sent only to a student's UT Dallas email address and UT Dallas will only consider email requests originating from an official UT Dallas student email account. This allows the University to maintain a high degree of confidence in the identity of each individual's corresponding via email and the security of the transmitted information. The University of Texas at Dallas furnishes each student with a free email account that is to be used in all communication with university personnel. The Office of Information Technology provides a method for students to have their UT Dallas mail forwarded to other email accounts. To activate a student UT Dallas computer account and forward email to another account, go to <http://netid.utdallas.edu>.

Class Attendance

Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. Absences may lower a student's grade where class attendance and class participation are deemed essential by the instructor. In some courses, instructors may have special attendance requirements; these should be made known to students during the first week of classes.

Withdrawal from Class

The administration at UT Dallas has established deadlines for withdrawal from any course. These dates and times are published in the Comet Calendar (<http://www.utdallas.edu/calendar>) and in the Academic Calendar <http://www.utdallas.edu/academiccalendar>). It is the student's responsibility to handle withdrawal requirements from any class. In other words, a professor or other instructor cannot drop or withdraw any student unless there is an administrative drop such as the following:

- Have not met the prerequisites for a specific course
- Have not satisfied the academic probationary requirements resulting in suspension
- Office of Community Standards and Conduct request
- Have not made appropriate tuition and fee payments
- Enrollment is in violation of academic policy
- Was not admitted for the term in which they registered

It is the student's responsibility to complete and submit the appropriate forms to the Registrar's Office and ensure that he or she will not receive a final grade of "F" in a course if he or she chooses not to attend the class after being enrolled.

Student Grievance Procedures

Procedures for student grievances are found in university policy UTDSP5005 (<http://policy.utdallas.edu/utdsp5005>). In attempting to resolve any student grievance regarding disputes over grades, application of degree plan, graduation/degree program requirements, and thesis/and dissertation committee, adviser actions and/or decisions, evaluations, and/or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originated.

Incomplete Grades

As per university policy, incomplete grades may be given, at the discretion of the instructor of record for a course, when a student has completed at least 70% of the required course material but cannot complete

all requirements by the end of the semester. An incomplete course grade (grade of 'I') must be completed within the time period specified by the instructor, not to exceed eight (8) weeks from the first day of the subsequent long semester. Upon completion of the required work, the symbol 'I' may be converted into a letter grade (A through F). If the grade of Incomplete is not removed by the end of the specified period, it will automatically be changed to F.

AccessAbility Services

It is the policy and practice of The University of Texas at Dallas to make reasonable accommodations for students with properly documented disabilities. However, written notification from the Office of Student AccessAbility (OSA) is required. If you are eligible to receive an accommodation and would like to request it for this course, please discuss it with your professor and allow one week advance notice. Students who have questions about receiving accommodations, or those who have, or think they may have, a disability (mobility, sensory, health, psychological, learning, etc.) are invited to contact OSA for a confidential discussion. OSA is located in the Student Services Building, SSB 3.200. They can be reached by phone at 972-883-2098, or by email at studentaccess@utdallas.edu.

Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities, including examinations and travel time for the observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, of the Texas Tax Code.

Students are encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment.

Excused students will be allowed to take missed exams or complete assignments within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the President of UT Dallas or from the President's designee. The chief executive officer or designee must take into account the legislative intent of Texas Education Code 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

Resources to Help You Succeed

The Office of Student Success operates the Student Success Center (SSC, <http://www.utdallas.edu/studentssuccess>), which offers assistance to students in the areas of writing, mathematics, communication, multiple science fields, reading, study skills, and other academic disciplines. These services are available through individual and small group appointments, workshops, short courses, and a variety of online and instructional technologies. All students enrolled at UT Dallas are eligible for these services.

The Math Lab gives short-term and semester long support for a variety of introductory and advanced mathematics courses. Students may drop in to visit with a math tutor on a regular basis. Comet card is required.

The Writing Center offers a collaborative learning environment for one-to-one and small group assistance with general and advanced writing assignments and overall writing skills. Scheduling an appointment is strongly recommended, but walk in appointments are possible if a tutor is available.

The Peer Tutoring program offers free tutoring assistance in multiple locations for many of the historically challenging undergraduate subjects at UT Dallas. Tutoring sessions, offered every weekday on a drop-in

basis, are one-on-one or in a small group format. The sessions are designed to meet students' individual questions and needs related to course/subject concepts. All peer tutors are current UT Dallas students who made an A- or better in the course and have a strong faculty/staff recommendation. Students should check the Student Success Center website each semester for subject offerings and session times.

The Peer-Led Team Learning (PLTL) program provides an active, engaged learning experience for students who meet in small groups once a week with a Peer Leader who helps guide them through a potentially difficult gateway course. Students that attend sessions regularly typically earn a half to a whole letter grade higher than students that do not participate in the PLTL program.

Supplemental Instruction (SI) provides free, peer-facilitated weekly study sessions for students taking historically difficult courses. SI sessions encourage active, collaborative learning based on critical thinking and transferable study skills. SI leaders attend lectures, take notes, and read assigned material just like the enrolled students. Students should check the SSC website for subject and session times.

The Communication Lab (CommLab) offers one-on-one and group consultations where you will gain practical feedback for improving oral and group presentations.

Success Coaches are available for individual student appointments to discuss study skills, time management, note taking, test taking and preparation, and other success strategies.

The Student Success Center's main office is located in the McDermott Library Building and can be contacted by calling 972-883-6707 or by sending an email to ssc@utdallas.edu.