



# MATH 436.01W – INTRODUCTION TO REAL ANALYSIS

## COURSE SYLLABUS: FALL 2024

**Office Hours:** On-Campus

Monday 10AM–11:30AM; Tuesday 11AM–12PM; Wednesday 10:30AM–12PM;

Tuesday 11AM–12PM

or by appointment.

**Office Phone:** 903-886-5944

**Office Fax:** 903-886-5945

**University Email Address:** [Mehmet.Celik@tamuc.edu](mailto:Mehmet.Celik@tamuc.edu)

**Preferred Form of Communication:** email

**Communication Response Time:** Student course-related questions or concerns through email are answered usually within 24 hours during weekdays (M-F).

**Class Meeting Time:** MW 12:30am - 1:45pm (discussions)

**Class Location:** BINB302

## COURSE INFORMATION

### MATERIALS

**Textbook(s) Required:** The main text is *Basic Analysis: Introduction to Real Analysis* by Jiří Lebl, final version available online at <http://www.jirka.org/ra/>. Another book that you may consider using is *Introduction to Real Analysis* by William Trench, Introduction to real analysis, Pearson Education, 2003. (Freely downloadable.)

[http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH\\_REAL\\_ANALYSIS.PDF](http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH_REAL_ANALYSIS.PDF).

Another book that you may consider using is Walter Rudin, *Principles of mathematical analysis*, 3rd ed., McGraw-Hill Book Co., New York, 1976.

International Series in Pure and Applied Mathematics. We may occasionally cover enrichment activities, not in the text.

### COURSE DESCRIPTION

The course covers various topics in Introduction to Real Analysis, including the real number system, sequences and series, limits, continuity, differentiation, the Riemann integral, sequences and series of functions, elementary metric space theory including compactness, connectedness, and completeness, as well as differentiation and integration of functions of several variables.

### STUDENT LEARNING OUTCOMES

By the end of the course, students should be able to:

1. Describe the real line as a complete, ordered field.
2. Use the definitions of convergence as they apply to sequences, series, and functions.
3. Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line.
4. Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis.
5. Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style and mechanics.
6. Determine the Riemann integrability of a bounded function and prove a selection of theorems concerning integration.
7. Recognize the difference between pointwise and uniform convergence of a sequence of functions.
8. Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.

## COURSE REQUIREMENTS

**Instructional Methods:** The course places a strong emphasis on in-class activities that foster the development of critical thinking skills among students. Prior to class meetings, students will receive information to prepare them for small group problem-solving sessions. These sessions will cover computational, concept-based, and discussion-oriented problems. During class time, the professor will fully engage students in their own learning by enabling them to think critically, discuss ideas, investigate concepts, and create solutions during group discussions. Students can expect a range of exciting in-class learning activities. Students will submit their work for grading and feedback at the end of each session, with daily participation grades returned at the next meeting.

### Course Evaluation Methods

This course will utilize the following instruments to determine student grades and proficiency of the learning outcomes for the course.

**Exam** – (proctored) There will be one In-term exam. You will have a period of 75 minutes to complete the exam.  
Monday October 21<sup>st</sup> (Week #9)

Make-up exam is possible only if there is a documented emergency.

**Final Exam:** (proctored) A Comprehensive Final Exam (2 hours of exam time).

**Final Exam Date:** Wednesday, December 11th from 1:15pm to 3:15pm

Each exam will be proctored in class

**Attendance:** Regular attendance in class is crucial for earning higher final grades. Active participation and engagement during class discussions are crucial to successful learning. The course material discussed during class is essential for

demonstrating proficiency in the subject. It is important for students to inform their instructors of any absences and to make up any missed work. Coordination with fellow students for class notes is recommended if a student cannot attend class. Let's aim for consistent attendance and active participation in class to reach our educational goals.

**In-class Participation** – During Monday and Wednesday's class meetings, we will discuss ideas, notions, and problems associated with that week's material. These problems will be distributed at the beginning of each class meeting. At the end of each class, you will submit a number of fully solved problems to receive participation credit for that day (the number will be announced at that day's meeting). You will work in groups but must submit your sheet with the solutions. More information will be provided during the first day of class.

**Homework:** There will be weekly homework assignments. Each assignment will be graded. Missed questions and answers without work do not earn credit. Each homework assignment's questions will be posted on the weekly module assignment under D2L. The due date for each assignment will be announced with the assignment. Late homework submission will not be accepted.

Submit your homework to **[Activities]→[Assignments] →[Homework # on the Assignment Submission Folders]** at D2L as

*LastName\_FirstName\_HW#?\_Math436.pdf* (Example: Celik\_Mehmet\_HW#2\_Math436.pdf).

The homework assignment you submit must be your own work. Plagiarism is strictly prohibited.

**The key to success:** We will use [the flipped classroom approach](#). Students will be more engaged in activities and discussions with their peers during class meetings. With this approach, the professor can provide individual attention to students during class time. Students can learn at their own pace and review materials as needed by accessing them outside of class. This teaching approach encourages collaboration among students as they work through concepts together. In this course, students watch lecture videos (prepared by the professor) before class meetings and then use class time to engage in active learning. [Here are suggestions to ensure success in this type of classroom](#). Finding a quiet and distraction-free environment is essential to ensure you can fully concentrate on video lectures. Keep a notebook and pen nearby to take notes throughout the lecture. To take effective notes, pay close attention to the video, pause the video frequently to take notes, rewind the video if you don't understand something, answer questions in the video, write down questions in your notes, and bring your questions to class or office hours for help and clarification. To participate effectively in class, ask questions, fully participate in class activities, collaborate with peers, offer help to peers, and seek support from peers when needed.

**Workload and Assistance:** To succeed in this course, it is recommended that you set aside two to three hours each day outside of class to review the material. This includes watching videos, reading, completing homework assignments,

and preparing for quizzes and exams. Depending on the week, you may need to allocate more or less time for these tasks. Collaborating with fellow classmates can also be beneficial, so don't hesitate to ask for help or clarification. To further assist you, your professor has reserved specific office hours in Binnion 323. If you have any questions or concerns, feel free to reach out via email. Please note that emails are generally answered within 24 hours during weekdays (M-F).

## GRADING

**Grading Matrix:** This class will be graded on a total points system. 400 points are possible in the class. The following grading matrix presents how your total score will be calculated at the end of Fall 2024 for the Math 436.01E course. All the grading instruments are assigned between the first day of class and the last day of class of the Fall 2024 semester. The Final Exam is the last grading instrument of the course; the Final Exam date is Wednesday, [December 11<sup>th</sup>](#) from 1:15pm to 3:15pm. The grade is entirely objective and is determined solely by student performance on each evaluation criteria (One Mid-term Exam, HW assignments, and the Final Exam). *Do not expect Extra Credit assignments!*

<b>Instrument</b>	<b>Value (points)</b>	<b>Total</b>
In-class Participation	There will be daily participation	70pts
Weekly HW Assignments	At the end of the semester, the two lowest grades will be dropped, and then the average of the rest of the homework assignments will be considered.	110pts
Mid-term Exam	One mid-term Exam (proctored in class)	110pts
Final Exam	One comprehensive final Exam (proctored in class)	110pts
Total:		400pts

Grade Determination:

A = 400 – 360 pts; i.e. 90% or better

B = 320 – 359 pts; i.e. 80 – 89 %

C = 280 – 319 pts; i.e. 70 – 79 %

D = 240 – 279 pts; i.e. 60 – 69 %

F = 239 pts or below; i.e. less than 60%

## TECHNOLOGY REQUIREMENTS

A computer algebra system will be used for some problem exploration, enhanced conceptual understanding, and to engage students as active participants in the learning process.

- **TI-83/84** or other calculators with similar capability is recommended.
- **Printer** to print homework and tests is recommended.
- **Scanner/digital camera/cell phone** that you can take pictures of your work and submit them to the Dropbox at the eCollege.
- **D2L:** As a student enrolled at Texas A&M University-Commerce, you have access to D2L. You will obtain course materials through D2L, (MyLe→ APPs→ D2L). The course materials are only for this course. You cannot distribute the course materials without permission of the Instructor. You also have an email account via myLeo - all my emails sent from D2L (and all other university emails) will go to this account, so please be sure to check your email regularly.

## BROWSER SUPPORT

D2L is committed to performing key application testing when new browser versions are released. New and updated functionality is also tested against the latest version of supported browsers. However, due to the frequency of some browser releases, D2L cannot guarantee that each browser version will perform as expected. If you encounter any issues with any of the browser versions listed in the tables below, contact D2L Support, who will determine the best course of action for resolution. Reported issues are prioritized by supported browsers and then maintenance browsers.

Supported browsers are the latest or most recent browser versions that are tested against new versions of D2L products. Customers can report problems and receive support for issues. For an optimal experience, D2L recommends using supported browsers with D2L products.

Maintenance browsers are older browser versions that are not tested extensively against new versions of D2L products. Customers can still report problems and receive support for critical issues; however, D2L does not guarantee all issues will be addressed. A maintenance browser becomes officially unsupported after one year.

Note the following:

- Ensure that your browser has JavaScript and Cookies enabled.
- For desktop systems, you must have Adobe Flash Player 10.1 or greater.

- The Brightspace Support features are now optimized for production environments when using the Google Chrome browser, Apple Safari browser, Microsoft Edge browser, Microsoft Internet Explorer browser, and Mozilla Firefox browsers.

### DESKTOP SUPPORT

<b>Browser</b>	<b>Supported Browser Version(s)</b>	<b>Maintenance Browser Version(s)</b>
Microsoft® Edge	Latest	N/A
Microsoft® Internet Explorer®	N/A	11
Mozilla® Firefox®	Latest, ESR	N/A
Google® Chrome™	Latest	N/A
Apple® Safari®	Latest	N/A

### TABLET AND MOBILE SUPPORT

<b>Device</b>	<b>Operating System</b>	<b>Browser</b>	<b>Supported Browser Version(s)</b>
Android™	Android 4.4+	Chrome	Latest
Apple	iOS®	Safari, Chrome	The current major version of iOS (the latest minor or <b>point</b> release of that major version) and the previous major version of iOS (the latest minor or <b>point</b> release of that major version). For example, as of June 7, 2017, D2L supports iOS 10.3.2 and iOS 9.3.5, but not iOS 10.2.1, 9.0.2, or any other version.

Device	Operating System	Browser	Supported Browser Version(s)
			Chrome: Latest version for the iOS browser.
Windows	Windows 10	Edge, Chrome, Firefox	Latest of all browsers, and Firefox ESR.

- You will need regular access to a computer with a broadband Internet connection. The minimum computer requirements are:
  - 512 MB of RAM, 1 GB or more preferred
  - Broadband connection required courses are heavily video intensive
  - Video display capable of high-color 16-bit display 1024 x 768 or higher resolution
- You must have a:
  - Sound card, which is usually integrated into your desktop or laptop computer
  - Speakers or headphones.
  - \*For courses utilizing video-conferencing tools and/or an online proctoring solution, a webcam and microphone are required.
- Both versions of Java (32 bit and 64 bit) must be installed and up to date on your machine. At a minimum Java 7, update 51, is required to support the learning management system. The most current version of Java can be downloaded at: JAVA web site <http://www.java.com/en/download/manual.jsp>
- Current anti-virus software must be installed and kept up to date.

Running the browser check will ensure your internet browser is supported.

Pop-ups are allowed.  
JavaScript is enabled.  
Cookies are enabled.

- You will need some additional free software (plug-ins) for enhanced web browsing. Ensure that you download the free versions of the following software:
  - [Adobe Reader](https://get.adobe.com/reader/) <https://get.adobe.com/reader/>
  - [Adobe Flash Player](https://get.adobe.com/flashplayer/) (version 17 or later) <https://get.adobe.com/flashplayer/>
  - [Adobe Shockwave Player](https://get.adobe.com/shockwave/) <https://get.adobe.com/shockwave/>
  - [Apple Quick Time](http://www.apple.com/quicktime/download/) <http://www.apple.com/quicktime/download/>

At a minimum, you must have Microsoft Office 2013, 2010, 2007 or Open Office. Microsoft Office is the standard office productivity software utilized by faculty, students, and staff. Microsoft Word is the standard word processing software, Microsoft Excel is the standard spreadsheet software, and Microsoft PowerPoint is the standard presentation software. Copying and pasting, along with

attaching/uploading documents for assignment submission, will also be required. If you do not have Microsoft Office, you can check with the bookstore to see if they have any student copies.

### **ACCESS AND NAVIGATION**

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or [helpdesk@tamuc.edu](mailto:helpdesk@tamuc.edu).

**Note:** Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

## **COMMUNICATION AND SUPPORT**

### **BRIGHTSPACE SUPPORT**

#### **NEED HELP?**

#### **STUDENT SUPPORT**

If you have any questions or are having difficulties with the course material, please contact your Instructor.

#### **TECHNICAL SUPPORT**

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778 or click on the **Live Chat** or click on the words "click here" to submit an issue via email.



#### **SYSTEM MAINTENANCE**

D2L runs monthly updates during the last week of the month, usually on Wednesday. The system should remain up during this time unless otherwise specified in an announcement. You may experience minimal impacts to performance and/or look and feel of the environment.

#### **INTERACTION WITH INSTRUCTOR STATEMENT**

Student course-related questions or concerns through email are answered usually within 24 hours during weekdays (M-F). Feedback on assessments will be provided within 7 days after the assignment is submitted.

My primary form of communication with the class will be through the official university Email and Announcements. Any changes to the syllabus or other important information critical to the class will be disseminated to students in this way via your D2L Email address available to me through MyLeo and in



Announcements. It will be your responsibility to check your official university Email and Announcements regularly.

**Discussions:** This space is for students to communicate with each other. I may visit Discussions and join your discussion. Please feel free to answer one another's questions. I will check answers (as well as questions) for correctness, but do not hesitate to respond to a posting if you feel you can answer the question thoroughly and directly.

## **STUDENT ACADEMIC RESOURCES**

**Math Lab:** Free tutoring service offered by the Mathematics department (Binnion Hall Room 328). Please visit the web site for the hours of operation and more details.

<http://www.tamuc.edu/academics/colleges/scienceEngineeringAgriculture/departments/mathematics/students/default.aspx>

**The TAMUC One Stop Shop** - provides as many student resources as possible in one location.

<http://www.tamuc.edu/admissions/oneStopShop/>

**The TAMUC Academic Success Center** provides academic resources to help you achieve academic success.

<http://www.tamuc.edu/CampusLife/CampusServices/AcademicSuccessCenter/default.aspx>

## **COURSE AND UNIVERSITY PROCEDURES/POLICIES**

### **COURSE SPECIFIC PROCEDURES**

#### **Policy for Reporting Problems with eCollege**

If students encounter D2L-based problems while submitting assignments and assessments, the following procedures MUST be followed.

1. Students must report the problem to the help desk. You may reach the helpdesk at [helpdesk@online.tamuc.org](mailto:helpdesk@online.tamuc.org) or 1-866-656-5511
2. Students MUST file their problem with the helpdesk and obtain a helpdesk ticket number
3. Once a helpdesk ticket number is in your possession, students should email me to advise me of the problem and to provide me with the helpdesk ticket number
4. At that time I will call the helpdesk to confirm your problem and follow up with you.

PLEASE NOTE: Your personal computer/access problems are not a legitimate excuse for filing a ticket with the help desk. You are strongly encouraged to check for compatibility of your browser BEFORE the course begins and to take the eCollege tutorial offered for students who may require some extra assistance in navigating the eCollege platform. ONLY D2L-based problems are legitimate.

## SYLLABUS CHANGE POLICY

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the Instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

## UNIVERSITY-SPECIFIC PROCEDURES

### Academic Honesty

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including (but not limited to) receiving a failing grade on the assignment, the possibility of failure in the course and dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. In ALL instances, incidents of academic dishonesty will be reported to the Department Head. Please be aware that academic dishonesty includes (but is not limited to) cheating, plagiarism, and collusion.

*Cheating* is defined as:

- Copying another's test or assignment
- Communication with another during an exam or assignment (i.e. written, oral or otherwise)
- Giving or seeking aid from another when not permitted by the Instructor
- Possessing or using unauthorized materials during the test
- Buying, using, stealing, transporting, or soliciting a test, draft of a test, or answer key

*Plagiarism* is defined as:

- Using someone else's work in your assignment without appropriate acknowledgement
- Making slight variations in the language and then failing to give credit to the source

*Collusion* is defined as:

- Collaborating with another, without authorization, when preparing an assignment

If you have any questions regarding academic dishonesty, ask. Otherwise, I will assume that you have full knowledge of the academic dishonesty policy and agree to the conditions as set forth in this syllabus.

### AI use policy

Texas A&M University-Commerce acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of

such requirements and follow their instructors' guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

13.99.99.R0.03 Undergraduate Academic Dishonesty  
13.99.99.R0.10 Graduate Student Academic Dishonesty

### **A&M-Commerce Supports Students' Mental Health**

**The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit [www.tamuc.edu/counsel](http://www.tamuc.edu/counsel)**

### **ADA STATEMENT**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

#### **Office of Student Disability Resources and Services**

Texas A&M University-Commerce

Gee Library- Room 162

Phone (903) 886-5150 or (903) 886-5835

Fax (903) 468-8148

Email: [studentdisabilityservices@tamuc.edu](mailto:studentdisabilityservices@tamuc.edu)

Website: [Office of Student Disability Resources and Services](http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/)

<http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/>

#### **Student Conduct**

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the [Student Guidebook](#).

<http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx>

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum:

[Netiquette http://www.albion.com/netiquette/corerules.html](http://www.albion.com/netiquette/corerules.html)

## **TAMUC Attendance**

For more information about the attendance policy please visit the [Attendance](#) webpage and [Procedure 13.99.99.R0.01](#).

<http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx>

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf>

## **Copyright Policy**

The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this course, which include but are not limited to syllabi, lecture notes, quizzes, exams, in-class materials, review sheets, projects, and problems sets. Because these materials are copyrighted, you do not have the right to copy and distribute the handouts.

## **NONDISCRIMINATION NOTICE**

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

## **CAMPUS CONCEALED CARRY STATEMENT**

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the [Carrying Concealed Handguns On Campus](#) document and/or consult your event organizer.

Web url:

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf>

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

## **COURSE OUTLINE / CALENDAR**

### **WEEKLY SCHEDULE:**

**(Week 1)** Basic Set Theory (Sets, Induction, Functions, Relations and Equivalence Classes, Cardinality)  
**(Week 2)** Real Numbers (Basic Properties, The Set of Real Numbers, Using Supremum and infimum)  
**(Week 3)** Absolute Values and Bounded functions, Intervals and the size of  $\mathbb{R}$ , Sequences and limits  
**(Week 4)** Monotone Sequence, Tail of a Sequence, Subsequences, Limits and inequalities, Continuity of Algebraic Operations, Some Convergence Tests,  
**(Week 5)** Upper and Lower Limits, Using Limit Inferior and Limit Superior, Cauchy Sequences  
**(Week 6)** Series (Geometric and Cauchy Series, Basic Properties, Absolute Convergence, Comparison and p-test, Ratio Test, Power Series)  
**(Weeks 7)** Limits of Functions, Sequential Limits, Limits of Restriction and One-Sided Limits,

**(Week 8)** Continuous Functions, Discontinuous Functions;  
**(Week 9) In term-Exam (Monday),** Min-max and Balzano's Intermediate Value Theorems,  
**(Week 10)** Uniform Continuity, Criterion for Non-Uniform Continuity, Lipschitz Continuous Functions, The Derivative and its Basic Properties  
**(Week 11)** Relative Maxima and Minima, Continuity of Derivatives and Intermediate Value Theorem, Taylor's Theorem  
**(Weeks 12&13)** The Riemann Integral; Properties of the integral; Fundamental theorem of calculus  
**(Weeks 14&15)** Sequence of Functions (Pointwise and uniform convergence; Interchange of limits; Picard's theorem)  
**(Week 16). Final Exam Week**

This schedule is subject to change by the Instructor. Any changes to this schedule will be communicated by email and announcements on the course web page. This schedule is subject to change by the Instructor. Any changes to this schedule will be communicated by email and announcements on the course web page.