MATH 4309 – Advanced Analysis

Catalog Description: A study of the theory of the calculus of functions of a single variable. Topics may include the topology of the real line, functions, sequences and their limits, continuity, differentiation, and integration. Prerequisite: MATH 2414.

Expanded Course Description: An introductory course in real analysis is universally foundational for undergraduate study in mathematics. As such, this course is a core requirement for the Bachelor of Science degree in Mathematics and is primarily intended for advanced undergraduate mathematics majors. The course topics include an introductory development of the real number system, sequences and their limits, and the continuity and differentiation of real functions.

Objectives: Students will be introduced to fundamental techniques for developing the theory of integrals, derivatives, and limits in one dimension, which will serve as a foundation for further mathematical study. Students will also study the development of the real number system and real valued functions. Finally, students will learn to use the styles and formats common to professional publications in mathematics to write definitions and proofs in real analysis. Upon completing MATH 4309, a student should be able to do the following:
1. Comprehend definitions,
2. State and rigorously prove related mathematical theorems using styles and formats appropriate to the disciplen,
3. Perform the computations related to the material,
4. Demonstrate the use of the theoretical results and computational aspects on required applications, and
5. Connect the material to other courses.

Strategy: Students will study the material outlined in the goals through class assignments and technological assignments. Students will be given the opportunity on homework, quizzes, projects and/or major exams to develop and maintain sophistication in using the basic techniques of Analysis. In addition, students will be required to present the concepts of this course in a written format consistent with the styles and format represented in the professional literature.

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University Policy: Students are responsible for knowing and abiding by the policies and information contained in the Tarleton Student Handbook [TSUSH].

Safety Measures
Tarleton State University has adopted policies and practices for the Spring 2021 term to limit transmission of the novel coronavirus. Students are required to observe the following practices while participating in face-to-face courses and course-related activities (office hours, moving between classes, study spaces, academic services, etc.):

- Self-monitoring – Students should follow CDC recommendations for self-monitoring. **Students who exhibit symptoms of COVID-19 (with or without fever) should participate in class remotely and should not participate in face-to-face instruction.** See https://www.tarleton.edu/roadmap/personal-responsibilities/ for more information. Students who test positive for COVID-19 or experience symptoms consistent with COVID-19 are required to self-report to Tarleton State University via this form.
- Face coverings – All students must properly wear face coverings in all public spaces on campus, including classrooms. If a student refuses to wear a face covering, the instructor will ask the student to leave and join the class remotely. Any student refusing to comply will be reported to the Dean of Students Administrative Office via the Student Affairs Incident Reporting Form. Additionally, the faculty member may choose to teach that day's class remotely for all students.
- Physical Distancing – Physical distancing must be maintained between students, instructors, and others in course and course-related activities.
- Classroom Entrance and Exit – Students should leave classrooms promptly after class activities have concluded each day. Students should not congregate in hallways or other areas and should maintain a safe physical distance when waiting to enter classrooms and other instructional areas.

Personal Illness and Quarantine/Isolation: Students who are required to quarantine (see https://www.tarleton.edu/roadmap/isolation-v-quarantine/) must participate in course and course-related activities remotely and **must not attend face-to-face course activities.** Students in quarantine are expected to participate in courses and course activities/assignments unless they have symptoms too severe to participate. Students placed in isolation should contact the instructor about individual participation in relation to severity of illness. Students who test positive for COVID-19 or who are experiencing symptoms consistent with COVID-19 are required to self-report to the Dean of Students Administrative Office through the COVID-19 Report Form. For any questions or concerns, please contact the Dean of Students Administrative Office at 254-968-9080.

Student Responsibilities: The student is *solely* responsible for:
- Completing each assignment by the specified due date.
- Obtaining assignments and other materials for classes from which they are absent.
- Utilizing, as needed, all available study-aid options (including meeting with the instructor, reading the assigned literature, researching in alternative literature, purchasing a student solutions manual, hiring a personal tutor, etc.) to resolve any questions that they might have regarding homework, course material, and/or technology projects.
- Giving as much of an effort as it takes to pass this course.

Academic Conduct: Tarleton State University expects its students to maintain high standards of personal and scholarly conduct. Students guilty of academic dishonesty are subject to disciplinary action. Academic dishonesty includes, but is not limited to, cheating on an examination or other academic work, plagiarism, collusion, and the abuse of resource materials. The faculty member is responsible for initiating action for each case of academic dishonesty that occurs in his or her class.

Services for Students with Disabilities: It is the policy of Tarleton State University to comply with the Americans with Disabilities Act (www.ada.gov) and other applicable laws. If you are a student with a disability seeking accommodations for this course, please contact the Center for Access and Academic Testing, at 254.968.9400 or caat@tarleton.edu. The office is located in Math 201. More information can be found at www.tarleton.edu/caat or in the University Catalog.

Absence Policy: Class absence policies will be established and enforced by each individual course instructor. The course instructor may recommend to the Dean of Students that a student be dropped from a course if excessive absences prevent satisfactory progress.

Makeup Policy: Each course instructor has the responsibility and authority to determine if work can be made-up because of absences. Students may request make-up considerations for valid and verifiable reasons such as the following:
- Illness
- Death in the immediate family
- Legal proceedings
- Participation in sponsored University activities (It is the responsibility of students who participate in University-sponsored activities to obtain a written explanation for their absence from the faculty/staff member who is responsible for the activity.)

Drop Policy: A student who withdraws from a course before the thirteenth class day of a regular semester or before the fifth class day in a summer term receives no grade, and the course will not be listed on that student's permanent record. A student who withdraws from a course before the end of the tenth week of a regular semester or the fourteenth class day of a summer term receives a grade of W or Q. Students who stop participating in the course will receive an FX grade that may affect financial aid.

Calculator Policy: All students are required to have an approved graphing calculator when taking this course. During the administration of a test, the use of calculators may be restricted, at the discretion of the instructor. Students may also be restricted to the use of a calculator that does not have course notes stored in the memory. The instructor reserves the right to examine and delete material from the memory of a student's calculator before approving its use on an exam.

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Instructor: Dr. Peter W. White   **Office:** Math 331
Phone #: 968-1982   **e-mail:** white@tarleton.edu
Math Office #: 968-9168   **Office Hours:** TBA

Text: Understanding Analysis by Stephen Abbott, 2nd edition.

Homework Policy: A list of assignment problems will be posted on Dr. White's web site
(http://faculty.tarleton.edu/white/). Homework will be assigned in class and submitted as a PDF document in
Canvas. Each assignment will be due at the beginning of second lecture period after the assignment was assigned
unless otherwise designated in class. Each assignment will be spot graded. Each assignment will be equally
weighted when calculating the Home Work grade. The instructor reserves the ability to drop some low scores
before calculating the Home Work grade.

Quizzes: Quizzes may be given instead of collecting the section of home work for a given day. The quiz score
will take the place of the home work score for that day. Quizzes will be at the beginning of the class period and
cannot be made up except in the case of a verifiable university recognized absence. Quizzes may take the form of
verbal presentation at the board/in Zoom of individual homework problems or parts thereof.

Exams: There will be three exams and a comprehensive final exam. More information will be given about the
exams by the instructor in a timely fashion.

Calculator Policy: An approved graphing calculator is required for this course. It is **highly
recommended** that the students use a TI-83, 83+, 84, 86, 89, TI-Enspire, or similar calculator.

Attendance Policy: Blended Hybrid-HyFlex courses are designed so that students can choose to
attend courses in two modalities: face-to-face (with the potential for rotation to maintain a safe
physical distance) or at the same time as the face-to-face class meetings but from a different
location (remote synchronous-Zoom). Students **must** attend class in one of these two
instructional modalities. Repeated absences may impact the student's ability to be successful in
the class and may lead to failure to earn credit for the course. Attendance will be taken of the
face-to-face students in case it is needed for contact tracing. Attendance will be recorded for
synchronous participation via Zoom. Students in this course will be allowed three (3) unexcused
absences. After that, each unexcused absence will deduct 6 points from their total for the
semester. The student is responsible for all material covered in class. The class sessions will be
recorded and posted in Canvas. The student may not be allowed to turn in late work or make up
exams or quizzes unless they have a verifiable university recognized absence.

Grading Policy:

Homework/Quizzes	100 pts	540-600 pts	A
Three exams	300 pts	480-539 pts	B
		420-479 pts	C
Final exam	200 pts	360-419 pts	D
		0-359 pts	F
Total	600 pts		

Notes:
- In the event that the university is closed for a scheduled class time, whatever was scheduled for that day and/or whatever was due that day will be scheduled and/or due on the next scheduled class time.
- You are expected to present a valid TSU ID upon request.
- **All items contained in this syllabus are subject to change as the semester progresses. Students will be notified in advance of any changes.**

Topics:
- The Irrationality of the square root of 2.
- The Axiom of Completeness.
- Cantor's Theorem.
- Infinite Series (Rearrangements).
- Limits of Sequences.
- Algebraic and Order Limit Theorems.
- Monotone Convergence Theorem.
- Bolzano-Weierstrass Theorem.
- Cauchy Criterion.
- Properties of Infinite Series.
- Double Summations and Products of Infinite Series.
- The Cantor Set.
- Open and Closed Sets.
- Compact Sets.
- Functional Limits.
- Combinations of continuous Functions.
- Continuous functions on Compact Sets.
- The Intermediate Value Theorem.
- Sets of Discontinuity.