



Forman Christian College, Lahore
(A Chartered University)
Department of Mathematics
Fall 2021

Instructor Information:

Dr. Ashar Ghulam

Ph.D. (Applied Mathematics)

M.S (Mathematics)

M.Phil. (Mathematics)

M.Sc. (Mathematics)

Assistant Professor

Office: S-114 (Armacost Science Building)

Office Hours: Mon, Wed, : 11:00 am - 11:50 am, Fri. 11:00 am-11:30 am,

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Course Information:

Course Title : Real Analysis

Course Code: MATH309

Section: A

Credit hours: 3

Prerequisite: MATH201

Room # : S- 413

Timing : Mon, Wed, Fri: 09:00 am-- 09:50 am

Recommended Text:

Introduction to Real Analysis, Robert G. Bartle, Donald R. Sherbert, 4th Edition, John Wiley & Sons Inc., U.S.A.

Reference Text:

Advanced Calculus: An introduction to linear analysis, Leonard F. Richardson (Herbert Huey McElveen Professor), John Wiley & Sons Inc., U.S.A.

Mode of teaching: Blended (Students with even and odd roll numbers will rotate after each week.)

I will provide the recorded lectures and lecture notes on Moodle. Assignment will be submitted on Moodle while midterm and final term examinations will be conducted in class.

Note: In case of in person (on campus) classes then there will be in class lectures. Assessments will be same for blended and in person (on campus) modes of teaching.

Course Contents:

This is an upper level core course (mandatory) for 4- year baccalaureate degree in Mathematics. This course will deal with sets and functions, the completeness property of set of Real Numbers \mathbb{R} , intervals, sequences, convergent and divergent sequences, limit of a function, continuous functions, uniformly continuous functions, and differentiable functions.

Course Objectives

The objectives of this course for students are to strengthen the theoretical aspects of the above listed topics. The students will be able to write mathematical proofs of certain theorems relating different properties of real valued functions. It will improve student's understanding about properties like limit, continuity and differentiability of a real valued function, and ability to independently increase their own understanding of theoretical aspects of these properties. It will provide students with an opportunity to appreciate beauty of mathematical thinking while writing theoretical proof of a theorem. Students will demonstrate the competence in applying different properties of a real valued function while writing proof of a certain theorem. Students will be able to apply theorems to solve related problems.

Course Expectations

- ❑ Students must arrive at class on time, should remain in class for the entire class period and mobile phones should be switched off. All students whose attendance is less than **70%** won't be allowed to take the final exam. Note that there are **05 marks for attendance and in class participation**, if a student arrives more than 10 minutes late or leaves class during lecture or uses mobile phone in class, he/she will be marked absent. Habitual late comers will not be allowed to enter the class after 10 minutes. In case, a late comer with **genuine reason** is not allowed to enter the class, he or she can see the professor in office hours for briefing about the lecture.
- ❑ Course assessment will be through quizzes, midterm, assignments, and attendance & in class participation and final exam. **If needed, students may be asked to explain the submitted work.** All assignments are to be completed by the date mentioned on the assignment paper. **Late submission of assignment will result in deduction of points for the assignment.** There is no make up for missed quizzes but best 3 out of 4 will be counted. In extreme cases average marks for the missed quizzes might be given provided students should submit strong evidence **within 3 days** after missing the quiz. Make up for midterm and final exam. is possible only under extremes cases if student provides strong documentary evidence **within 3 days after missing the Mid/Final exam.** In case of make up examination, there will be a 0-20% deduction in marks depending upon case to case. Medical certificate will be acceptable if it is verified by the medical officer of FCCU. In the final exam., there will be an extra credit question.
- ❑ **Academic dishonesty or cheating** will result in zero points (grade F) and will be referred to AIC (Academic Integrity Committee) at FCCU for necessary action. (Page 20 of 4-year Baccalaureate degree Program Catalog 2018-2019)

Learning Outcomes

Students will be able to:

- ▢ develop and strengthen skills in understanding theoretical definitions of limit, continuity and differentiability of a real valued function.
- ▢ write theoretical proof of a certain theorem relating different properties of a real valued function.
- ▢ understand the relationship between limit, continuity and differentiability of a real valued function.
- ▢ study the Riemann integration theory.
- ▢ better understand the mathematical properties being used in other fields.

Course Evaluation

Grading will be based on following criteria:

Attendance & in class performance	05 %
Assignments (2)	10 %
Quizzes (3 out of 4)	15 %
Mid Term	30 %
Final Exam	40 %

<u>Grades</u>	<u>Quality Points</u>	<u>Numerical Value</u>	<u>Meaning</u>
A	4.00	93-100	Superior
A-	3.70	90-92	
B+	3.30	87-89	
B	3.00	83-86	Good
B-	2.70	80-82	Fair
C+	2.30	77-79	
C	2.00	73-76	Satisfactory
C-	1.70	70-72	
D+	1.30	67-69	
D	1.00	60-66	Passing
F	0.00	59 or below	Failing

Course Outline

Week	Topics	Quizzes
1 Nov. 01,03,05	Discussion of course plan: Course introduction, Policies, Requirements, and grading criteria. Sets and functions, finite and infinite sets	
2 Nov.08,10,12	The algebraic and order properties of \mathbb{R} , The completeness property of \mathbb{R} .	
3 Nov.15,17,19	The supremum property of \mathbb{R}	Assignment-1
4 Nov. 22, 24,26	Intervals, Nested intervals	
5 Nov.29, Dec. 01, 03	Sequences and their limits, Monotone sequences, and related theorems,	Quiz-1
6 Dec.06, 08,10	Subsequences and Bolzano-Weierstrass theorem,	
7 Dec.13, 15,17	Properly divergent sequences and related theorems.	Quiz-2
8 Dec. 20	Limit of a function, Limit theorems.	
9 Jan.03,05,07	Continue limit theorems and their applications,	Mid-Term

10 Jan.10,12,14	Continuous functions, Combinations of continuous functions, Continuous functions on intervals.	
11 Jan. 17,19,21	Uniform continuity and related theorems.	Quiz-3
12 Jan.24,26,28	Monotone and inverse functions, Derivative of a real valued function,	
13 Jan.31, Feb.02,04	Theorem relating continuity and differentiability of a real valued function, Caratheodory's theorem,	Assignment-2
14 Feb. 7,9,11	Chain rule, Rolle's theorem, The mean value theorem	
15 Feb.14,16, 18	L'Hospital Rules and related problems, Taylor's theorem	Quiz-4
	Final examination period is from 21 st Feb. 2022 – 02 nd March 2022. Note: Final examination will be taken from the whole syllabus.	Final Exam.