هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	**Real Analysis**
Course Code:	**MAT 1311**
Program:	**Bachelor of Science in Applied Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2024 – V1**
Last Revision Date:	**08/10/2024**

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A. General information about the course:

1. Course Identification

1. Credit hours:					
4 (3 Lectures, 0 Lab, 2 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Program	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Level 5 / Year 3					
4. Course general Description:					
The Real Analysis course offers a rigorous foundation in the properties of real numbers and functions. Topics include the fundamentals of real numbers, limits, sequences, and continuity, as well as differentiation and the Mean Value Theorem. Students will also study Riemann integrals and the Fundamental Theorem of Calculus, along with sequences of functions, focusing on pointwise and uniform convergence.					
5. Pre-requirements for this course (if any):					
MAT 1203					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
The main objective of this course is to provide students with a rigorous understanding of the foundational concepts in analysis that underpin advanced mathematical techniques. It equips students with critical analytical skills essential for tackling complex problems in various applied fields, such as engineering, physics, and economics. This course also prepares students for further studies in topics such as topology, optimization, numerical methods, and mathematical modeling, ensuring they have a solid theoretical base for practical applications.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	30
5.	**Others (specify)**	0
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Summarize the fundamental concepts real sequences and real functions of a single variable: continuity, limits, differentiation, integration, and convergence types.	K1	4 lecture hours\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
1.2	Describe the real line as a complete, ordered field, and basic differences between the rational and the real numbers, as well as the difference between pointwise and uniform convergence of a sequence of functions.	K1, K2	4 lecture hours\week 2 tutorial hours\week Self-study	Regular Exams Assignments Short Quizzes
2.0	**Skills**			
2.1	Construct appropriate logical structure of proofs based on Stone-Weierstrass' theorem, Cauchy criterion, the contraction theorem, the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis.	S1, S2	Self-study Real-life problems	Participations Short Quizzes
2.2	Communicate mathematical ideas in written form.	S4	Self-study Real-life problems	Participations Short Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	Appraise how to search the internet and use software programs to deal with problems.	S5	Self-study Real-life problems	Participations Short Quizzes
2.4	Compute, in rigorous mathematical way, the real analysis tools, such as the limit of sequences/sum of series/ sequence of functions and Riemann integrals.	S3	Self-study Real-life problems	Participations Short Quizzes
3.0	**Values, autonomy, and responsibility**			
3.1	Independently, create approaches to unfamiliar mathematical problems.	V1, V3	Class discussion.	Participation
3.2	To work in groups.	V1, V2	Team work	Homework and Mini-projects

C. Course Content

No	List of Topics	Contact Hours
1.	**Fundamentals:** The field of real numbers; The least upper bound property; Completeness property; Archimedean property; Density of Rationales in the set of real numbers, Nested Intervals property.	**15**
2.	**Real sequences:** Formal definition of the limit; Limit theorems; monotonicity; Boundedness; Subsequences and Bolzano-Weierstass Theorem; Cauchy criterion.	**15**
3.	**Limits and Continuity:** Formal definition of the limit; right and left limits; continuity; Continuous Functions on Intervals; uniform continuity.	**15**
4.	**Differentiation:** Derivative of a function; The Mean Value Theorem; main applications to calculus.	**8**
5.	**Riemann's Integral:** Riemann Sums, Riemann Integral, Properties of Riemann Integral, Case of Monotonic Functions, Case of Continuous Functions, The Fundamental Theorem of Calculus.	**12**

6.	**Sequences of functions:** Pointwise convergence, uniform convergence, applications on uniform convergence.	**10**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWorks, Quizzes, Mini-projects	During the term	10%
2.	First Midterm	Week 5-6	25%
3.	Second Midterm	Week 10-11	25%
4.	Final Exam	Week 15	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	***Introduction to Real Analysis, 4th Edition; R. Bartle, D. Sherbert, Wiley,2011. (Main Reference)***
Supportive References	***Introduction to Real Analysis*, William F. Trench, (Pearson Education)** ***Real and Complex Analysis*, W. Rudin, 3rd edition, McGraw-Hills, 1987.**
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms:** Equipped with whiteboards, projectors, and Smart Boards for interactive lessons and group discussions. • **Laboratories:** Feature computers with internet access, enabling hands-on activities and exploration of algebraic and trigonometric concepts. • **Exhibition Rooms:** Spaces for showcasing projects and presentations to encourage collaborative learning.
Technology equipment (projector, smart board, software)	• **Data Show Projectors:** For clear presentations in classrooms and labs. • **Smart Boards:** To enhance interactivity during lessons. • **Mathematical Software:** Essential for graphing and analysis.
Other equipment (depending on the nature of the specialty)	• **Computers:** For mini-project and homework and practical applications in laboratories. • **Advanced Calculators:** For computations and problem-solving and supporting the study of limits, continuity, and differentiation.

Items	Resources
	• **Whiteboards and Markers:** To facilitate brainstorming and collaboration.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student and teaching staff	Surveys and Questionnaires
Effectiveness of Students assessment	Course Coordinator	Peer Reviews
Quality of learning resources	Students and teaching staff	Classroom Observations
The extent to which CLOs have been achieved	Student Representatives	Student Performance Evaluations (exams, projects) CLOs Excel sheet.
Other	**None**	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	8/1446
DATE	05/04/1446 (08/10/2024)