Course Specifications

Course Title:	**Real Analysis (2)**
Course Code:	**2304312-3**
Program:	**Bachelor of Mathematics**
Department:	**Mathematics Department**
College:	**Jamoum University College**
Institution:	**Umm Al-Qura University**

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A. Course Identification

1. Credit hours: 3 hours
2. Course type **a.** University ☐ College ☐ Department ☒ Others ☐ **b.** Required ☒ Elective ☐
3. Level/year at which this course is offered: Sixth Level / Third Year
4. Pre-requisites for this course (if any)**:** Real Analysis (1)
5. Co-requisites for this course (if any)**:** Does not exist.

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	3 hours per week	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	0	0%

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	(3 hours) x (15 weeks)
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	45
Other Learning Hours*		
1	**Study**	(1 hour) x (15 weeks)
2	**Assignments**	(1 hour) x (15 weeks)
3	**Library**	(1 hour) x (15 weeks)
4	**Projects/Research Essays/Theses**	0
5	**Others** (specify)	0
	Total	45

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

This course is a continuation of Real Analysis I. The topics covered are: real numbers and their basic properties, continuous functions and uniform continuity, differentiation and mean value theorems, Riemann integral, the Fundamental Theorem of Calculus, sequences, convergence, subsequences, Cauchy sequences, series, power series and Taylor series.

2. Course Main Objective

The aim of this course is to provide students with main concepts of real analysis, theory of integration, sequences and series of functions.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
1.1	State the different rules of differentiability and continuity of a real function.	
1.2	Define the Riemann integral (both definite and improper) and their properties.	
1.3	Memorize the Fundamental theorem of Calculus.	
1.4	Recognize the different series of functions.	
1.5	List the different convergence tests of a series of functions.	
2	**Skills:**	
2.1	Apply mathematical concepts and principles to prove the differentiability and continuity of a real function.	
2.2	Prove the elementary properties of the Riemann integral.	
2.3	Use the Fundamental theorem of Calculus in Riemann Integration.	
2.4	Determine whether a series of functions is pointwise convergent and if it is uniformly convergent.	
3	**Competence:**	
3.1	Write clear and precise proofs.	
3.2	Communicate effectively in both written and oral form.	
3.3	Use the theories, methods and techniques of the course to solve complex mathematical problems.	

C. Course Content

No	List of Topics	Contact Hours
1	**Brief Review:** - Real numbers. - Limits, continuity, Uniform continuity. - Differentiability and Examples. - Rules of Differentiability and Problems.	15
2	**Riemann Integral:** - Riemann Integration and Examples. - Fundamental theorem of Calculus	15
3	**Series of Functions:** - Series of functions. - Power Series.	15
	Total	**45**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1	**Knowledge:**		
1.1	State the different rules of differentiability and continuity of a real function.	Lecture. Memorization.	Exams (Midterm and Final). Quizzes.
1.2	Define the Riemann integral (both definite and improper) and their properties.	Lecture. Memorization.	Exams (Midterm and Final). Quizzes.
1.3	Memorize the Fundamental theorem of Calculus.	Lecture. Memorization.	Exams (Midterm and Final). Quizzes.
1.4	Recognize the different series of functions.	Lecture. Memorization.	Exams (Midterm and Final). Quizzes.
1.5	List the different convergence tests of a series of functions.	Lecture. Memorization.	Exams (Midterm and Final). Quizzes.
2	**Skills:**		
2.1	Apply mathematical concepts and principles to prove the differentiability and continuity of a real function.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
2.2	Prove the elementary properties of the Riemann integral.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
2.3	Use the Fundamental theorem of Calculus in Riemann Integration.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
2.4	Determine whether a series of functions is pointwise convergent and if it is uniformly convergent.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
3	**Competence:**		
3.1	Write clear and precise proofs.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
3.2	Communicate effectively in both written and oral form.	Lecture. Small group work.	Exams (Midterm and Final). Homework.
3.3	Use the theories, methods and techniques of the course to solve complex mathematical problems.	Lecture. Small group work.	Exams (Midterm and Final). Homework.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Midterm Test (1)	6^{th} week	20%
2	Midterm Test (2)	12^{th} week	20%
3	Homework and Quizzes	During the semester	10%
4	Final Examination	End of semester	50%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

Each group of students is assigned to a faculty member where he or she will provide academic advising. All faculty members are required to be in their offices outside teaching hours. Each faculty member allocates at least 4 hours per week to give academic advice and to answer to the questions of students about concepts studied during the lectures.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Introduction to Real Analysis (4th Edition), Robert G. Bartle and Donald R. Sherbert, Wiley (2011).
Essential References Materials	An Introduction to Classical Real Analysis, Karl R. Stromberg, American Mathematical Society (2015)
Electronic Materials	None.
Other Learning Materials	None.

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Large classrooms that can accommodate more than 50 students.
Technology Resources (AV, data show, Smart Board, software, etc.)	Data Show.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Students	Direct
Quality of learning resources.	Students	Direct
Extent of achievement of course learning outcomes.	Faculty member	Direct

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Council of the Mathematics Department
Reference No.	
Date	