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| Faculty: Science |
| Department: Mathematics Program: Bachelor's |

Course Plan

First: Course Information

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|-------------------------|--|--|----------------------|
| Course Name | Real Analysis I | Course Number | 0301311 |
| Credit Hours | 3 hours | Theoretical | 3 hours |
| Prerequisite | 0103151 | Section Number: 1 | Lecture Time: |
| Level in JNQF | 7 | | |
| Type Of Course | <input type="checkbox"/> Obligatory Faculty Requirement | <input type="checkbox"/> Elective University Requirement | |
| | <input type="checkbox"/> Obligatory University Requirement | <input type="checkbox"/> Faculty Requirement | |
| | <input type="checkbox"/> Course Elective Specialty Requirement | <input checked="" type="checkbox"/> Obligatory Specialization Requirement | |
| Type of Learning | <input checked="" type="checkbox"/> Face-to-Face Learning | | |
| | <input type="checkbox"/> Blended Learning (2 Face-to-Face + 1 Asynchronous) | | |
| | <input type="checkbox"/> Online Learning (2 Synchronous + 1 Asynchronous) | | |

Third: Course Description

Properties of real numbers, upper and lower bounds of a set, the completeness property of real numbers, density theorem, Nested sets, Open and closed Sets Dense Set, Sequence and subsequences, Bolzano - Weierstrass theorem, Cauchy sequences, limit and Continuity of real functions, Uniform Continuous, differentiability, Rolle's theorem, Mean value theorem, L' Hopital rule, Taylor theorem.



Fourth: Course Objectives

This class serves as an introduction to Real Analysis. This course designed to bridge the gap between the introductory calculus courses, which typically stress calculation rather than rigor, and the sophisticated analysis courses found at the senior and graduate levels. This course gives students the opportunity to learn the importance of the mathematical rigor, to think logically, precisely and mathematically, and to construct mathematically correct and concise proofs. The course will also develop the ability of students to express themselves clearly and concisely in writing, which becomes increasingly important in more advance courses. The following are the main objectives of this course:

1. Have the knowledge of basic properties of the field of real numbers.
2. Studying the basic topological properties of the real numbers.
3. Have the knowledge of the sequence of real numbers and convergence.
4. Studying Bolzano –Weirstrass theorem and Cauchy criteria.
5. Have the knowledge of limits of real functions and their properties.
6. Studying the notion of continuous functions and their properties.
7. Studying the differentiability of real functions and related theorems.

Fifth: Learning Source

| | | | |
|--|---|-------------------------------|--|
| Main Reference | Introduction to Real Analysis | | |
| Author: Ropert G. Bartle & Donald R. Sherbert | Issue No.: Fourth Edition | Publication Year: 2012 | |
| Additional Sources & Websites: | <i>Elements of real analysis- Charles G. Denlinger, Jones & Bartlett</i> <i>A course in Real Analysis, Hugo D. Jungh</i> | | |
| Teaching Type: | <input checked="" type="checkbox"/> Classroom <input type="checkbox"/> Laboratory <input type="checkbox"/> Workshop <input type="checkbox"/> MS Teams <input type="checkbox"/> Moodle | | |

Sixth: Learning Outcomes

| Level descriptor according to (JNQF) | CILOs Code | Course Intended Learning Outcomes (CILOs) | Associated PILOs Code Choose one PILO for each CILO* | Assessment method** Choose at least two methods | Scores out of 100 State the total score identified for each CILO | Minimum acceptable Score/percentage (%) The percentage should not be less than 50% *** |
|--------------------------------------|------------|---|---|--|---|---|
|--------------------------------------|------------|---|---|--|---|---|



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|--------------|----|--|-----|---|----|---------|
| Knowledge | K1 | Giving an idea for topology on real line | PK2 | First Exam, Second Exam, Final Exam | 30 | 15(50%) |
| | K2 | Giving some prosperities of real line. | PK2 | | | |
| | K3 | Aiding the student in his future mathematical studies | PK3 | | | |
| | K4 | Understanding topics in mathematics | PK4 | | | |
| Skills | S1 | Describe different examples about real analysis. | PS2 | First Exam, Second Exam, Quiz, Final Exam | 40 | 20(50%) |
| | S2 | Illustrate the application of learned theories | PS1 | | | |
| | S3 | Explaining the theories | PS2 | | | |
| | S4 | Apply the theories in solving problems | PS3 | | | |
| | S5 | Classify real space R and its properties using separation axioms and connectedness | PS2 | | | |
| Competencies | C1 | Writing concise proofs by analyzing basic information and properties | PC1 | First Exam, Second Exam, Quiz, Final Exam | 30 | 15(50%) |
| | C2 | Reach to new results by combining different theorems | PC2 | | | |
| | C3 | Solving problems in real analysis to build deep thinking and to become active in the communications | PC3 | | | |
| | C4 | Constructing a proof of theorems | PC4 | | | |
| | C5 | Discussion of how to practically apply the theorems of real analysis and skills development partnership and cooperation to work in a spirit of collective action | PC3 | | | |

*Refer to document () and page 2 in document ()

** Refer to document ()

**80% of the students must achieve the minimum acceptable percentage or higher for each CILO

Seventh: Course Structure

| | Intended Teaching Outcomes (ILOs) | Topics | Teaching Procedures* | Teaching Methods** | References*** |
|--|-----------------------------------|--------------|----------------------|------------------------------------|----------------|
| | | Outline | | | |
| | K1, K2, S1, S2 | Introduction | Face-to-face | Lectures, cooperative learning and | Main Reference |



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|--------------------|------------------------------------|--|--------------|---|----------------|
| | | | | discussion | |
| | K1, K2, S1, S2, C1 | Real numbers and sets, Axioms of ordering | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, S1, S2, C1 | Bounded, subsets of real numbers | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, S1, S2, C1, C2 | dense of rational numbers, Definitions of limits | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, C1, C2 | Applications on Limits, Convergent of sequences by using limits | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K4, S1, S2, C1, C2 | Applications on Convergent Sequence | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1 | Algebraic structures of sequences, subsequences | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1 | Increasing & decreasing (monotonic) sequences | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| First Exam | | | | | |
| | K1, K2, K5, S1, S2, S4, C1, C2 | limits points, | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| Eid Al-Fitr | | | | | |
| | K1, K2, K5, S1, S2, S4, C1, C2 | Bolzano–Weierstrass theorem, Applications on Bolzano–Weierstrass theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S5, C1, C2 | Limits theorem, Applications on Limits theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1, C2, C3 | Cauchy sequence | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1, C2, C3 | Compactness | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1, C2, C4 | Definition of continuous function composition of continuous function | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| Labor Day | | | | | |
| | K1, K2, K3, S1, S2 | algebraic operation for continuous functions | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| Second Exam | | | | | |



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|------------|---|---|--------------|---|----------------|
| | K1, K2, K3, S1, S2, S3, C1, C2, C5 | Cluster points, exterior points, Boundary points | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, K4, S1, S2, S3, C1, C2, | Accumulations points | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, K4, S1, S2, S3, C1, C2, | Definition of derivative | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, K4, S1, S2, S3, C1, C2, | Chain rule Applications on Chain rule | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, K4, S1, S2, S3, C1, C2, | Rolls theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, C1, C2, C3 | Applications on Rolls theorem Mean Value Theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, S4, C1, C2, | Applications on Mean value Theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| | K1, K2, K3, S1, S2, S3, S4, S5, C1, C2, | L'hospitals rule Theorem | Face-to-face | Lectures, cooperative learning and discussion | Main Reference |
| Final Exam | | | | | |

* Learning procedures: (Face-to-Face, synchronous, and asynchronous).

** Teaching methods: (Lecture, video.....).

*** Reference: (Pages of the book, recorded lecture, video....

Eighth: Assessment methods

| Methods | Direct Teaching | Specific Course Output to be measured | | | | | | | | | | | | | |
|------------|-----------------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | *State the score identified for each CILO for each method of assessment out of 100 | | | | | | | | | | | | | |
| | | **If any CILO will not be assessed in the course, mark NA. | | | | | | | | | | | | | |
| | | K1 | K2 | K3 | K4 | S1 | S2 | S3 | S4 | S5 | C1 | C2 | C3 | C4 | C5 |
| First Exam | 20 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | | | | | | |



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|--------------------|------------|--|-----------|----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|----------|----------|
| Second Exam | 20 | | 3 | 4 | 3 | 3 | 2 | | 2 | | | 3 | | | |
| Final Exam | 50 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 4 | 4 | 5 | 5 | 5 |
| Assignment | 10 | | | | | | 2 | 2 | 2 | | 2 | 2 | | | |
| Total | 100 | | 30 | | | 40 | | | | 30 | | | | | |

Ninth: Course Policies

- All course policies are applied on all teaching patterns (online, blended, and face-to-face Learning) as follows:
 - a. Punctuality.
 - b. Participation and interaction.
 - c. Attendance and exams.
- Academic integrity: (cheating and plagiarism are prohibited).

