

**Salahaddin University-Erbil**

**Foundations of Mathematics II**

**Course Book**

**2024 - 2025**

**First stage- Second semester**

**College: Education**

**Department: Mathematics**

**Academic year: 2024-2025**

**Academic staff: Dr Hogir Mohammed Yaseen**

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**Course Description**

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| **Module: Foundations of Mathematics** **II** | **Language : English** |
| **7 ECTS** | **Course code : EdM0106** |
| **Academic Year : 2024-2025** | **Semester: Fall** |
| **Contact** : **e-mail:** [hogr.yaseen@su.edu.krd](mailto:hogr.yaseen@su.edu.krd)  **Tel: (optional)07504154982** | **Keywords: Function, construction of Numbers, Group , ring , Field.** |
| **Teacher's academic profile**  **1. B.Sc. in Mathematics, 2007, Salahaddin University-Erbil.**  **2. M.Sc. in Algebra, 2010, Salahaddin University-Erbil.**  **3. PhD, in representation of Lie algebras, University of Leicester 2018.** | |
| **Course Content:** | |
| In this semester, first we study functions and their properties. We use them in the construction of numbers. Next, we explore different types of functions, their properties, and operations such as composition. Following that, we delve into Cardinality and Equivalence of sets. Additionally, we examine finite sets, infinite sets, denumerable sets, countable sets, Cantor sets, and uncountable sets. Afterward, we focus on the construction of numbers. We begin with a historical background of numbers, followed by a step-by-step explanation of numbers through axioms until students grasp the concept of numbers (natural numbers, integers, rational numbers, irrational numbers, real and complex numbers) and understand how they are constructed. Furthermore, we prove some properties related to them. Finally, we study an introduction about group, ring and field. | |
| **Course Objective** | |
| Foundations of mathematics is the study of the basic mathematical concepts (Mathematical logic, set theory, Relation, function, Construction of numbers(Natural Numbers, Integers, Rational Numbers, Irrational Numbers, Real Number, Complex Number), Group, Ring, Field, Cardinality) and how they form hierarchies of more complex structures and concepts, especially the fundamentally important structures that form the language of mathematics.  Foundations of mathematics involve studying basic mathematical concepts such as mathematical logic, set theory, relations, functions, and various number systems (natural numbers, integers, rational numbers, etc.). These concepts form hierarchies of more complex structures fundamental to the language of mathematics. The study aims to deepen understanding of these fundamental structures, enhance logical reasoning skills through formal logic and proofs, and explore foundational mathematical structures and their properties. | |
| **Learning Outcomes** | |
| A Foundations of Mathematics I+II course is designed to give students the basic skills and ideas they need for more advanced math. It teaches students how to think logically and learn different types of proof methods, like direct proof, proof by contradiction, and mathematical induction. These skills are important for understanding and creating clear mathematical arguments. Students also learn about set theory, including operations, Venn diagrams, and set identities. These concepts are used in areas such as counting, probability, and logical thinking. The course includes lessons on functions and relations, looking at their properties like injectivity, surjectivity, and bijectivity, and how to represent them in graphs. These topics help students understand how to model real-world situations. Algebra skills are also practiced through working with expressions, solving equations, and learning about basic algebraic structures.  In addition, students improve their ability to read and write mathematical proofs, which helps them think more clearly and make better arguments. This well-rounded approach prepares students to look at problems carefully, build mathematical models, and use these ideas in different areas, helping them develop analytical thinking and problem-solving skills in real-life situations.  By the end of a Foundations of Mathematics I+II course, students should be able to confidently solve various mathematical problems using logical reasoning and proof techniques. They should also be able to read, understand, and create their own mathematical proofs, strengthening their ability to think critically and communicate their ideas clearly.  Students will also be equipped with the ability to apply mathematical concepts in different fields, such as science, engineering, and physics. This course helps build a strong mathematical foundation, preparing students for future studies and real-world applications where precise and logical thinking is important. | |
| **References: \*** | |
| [1] H Behnke, F Bachmann, and Fladt. Fundamentals of mathematics, 1974. [2] Alan G Hamilton. Numbers, sets and axioms: the apparatus of mathematics. Cambridge University Press, 1982. [3] Elliott Mendelson. Number systems and the foundations of analysis. Technical report, 1973. [4] Ian Stewart and David Tall. The foundations of mathematics. OUP Oxford, 2015. [5] Raymond L Wilder et al. Introduction to the Foundations of Mathematics. Courier Corporation, 2012 [6] **اسس الرياضيات جزء الاول والثاني** | |
| **Type of Teaching: \*** 2 hours discussion+4 hours theoretical | |
| Different forms of teaching will be used to reach the objectives of these courses to the students: power point presentation for the course outline, head titles, definition, discussion and conclusions. Also, we shall use the blackboard for solving and explaining the examples. | |
| **Requirements For Credit Points: \* Modules Course Requirements:** | |
| 1. Students have an obligation to arrive on time and remain in the classroom for the duration of scheduled classes and activities.  2. Students have an obligation to write, homework’s, tests and final examinations at the times scheduled by the teacher or the College. Students have an obligation to inform themselves of, and respect, College examination procedures.  3. Students have an obligation to show respectful behavior with teacher and their class mates.  4. Electronic/communication devices (including cell phones, mp3 players, etc.) have the effect of disturbing the teacher and other students. All these devices must be turned off and put away. Students who do not observe these rules will be asked to leave the classroom.  5. Midterm exam, report, quiz, H.W and assignments and discussion in class are required**.** | |
| **Grade Distribution: \*** | |
| The assessment is divided up as follows: 1) Discussion 5 Marks  Report and seminar 5 Marks  Quiz 6 Marks (2 quizzes and each of them is 3 marks) Assignment and participation 4 Marks  Total is equal to 20 Marks and Midterm tests 20 Marks  2- Final Examination 60 Marks | |

**Weekly Plan**

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| **Detail** | |
| **Week** | **Detail** |
| **1** | Introduction to foundations of Mathematics II and Function |
| **2** | Some definitions and properties of functions especially domain, codomain, range, injective, surjective, Bijective  • Type of functions (Inclusion function, Characteristic function, Polynomial  function, …), Composition of functions, Inverse of functions |
| **3** | Cardinality, Equivalent sets and Finite sets |
| **4** | Infinite sets and denumerable sets and some properties of them |
| **5** | countable sets, cantor sets and uncountable sets |
| **6** | Construction of natural numbers |
| **7** | Some properties of natural number |
| **8** | Construction of integer numbers |
| **9** | Some properties of integer number |
| **10** | Review **and Mid-term exam** |
| **11** | Construction of rational numbers |
| **12** | Construction of irrational numbers |
| **13** | Construction of real and complex numbers |
| **14** | Basic defines about Group , Ring and Field |

**Workload**

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| **Module\* : Foundations of Mathematics II** | | | |
| **This Prerequisite module.** | | | |
| **Detail: 189 /27= 7 ECTS** | | | |
| **Type** | **Number** | **Time Factor** | **Total** |
| Attendance | 14 | 6 | 84 |
| Report | 1 | 11 | 11 |
| Mid Term Exam | 1 | 20 | 20 |
| Seminar | 14 | 1 | 14 |
| Class work | 14 | 1 | 14 |
| Discussion | 10 | 1 | 10 |
| Quiz | 4 | 4 | 16 |
| Site visit | 0 | 0 | 0 |
| Final exam | 1 | 20 | 20 |
|  |  |  | **189** |