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**Department of Software and Informatics Engineering**

**College of Engineering**

**University of Salahaddin-Erbil**

**Subject: Discrete Mathematics**

**Course Book: First Year Students (Second (Spring) Semester)**

**Lecturer's name: Lecturer Salar Jamal Atroshi**

**Academic Year: 2023-2024**

**Course Book**

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| **Course name** | **Discrete Mathematics** |
| **Lecturer in charge** | **Lecturer Salar Jamal Atroshi** |
| **Department/ College** | **Software and Informatics Engineering/ College of Engineering** |
| **Contact** | **Official E-mail:** [**salar.atroshi@su.edu.krd**](mailto:salar.atroshi@su.edu.krd)  **Personal E-mail:** [**salar\_atroshi@yahoo.com**](mailto:salar_atroshi@yahoo.com) |
| **Time (in hours) per week** | **Theory: 4 hours/week** |
| **Office hours** | **Daily from 8:30 till 2:30 except the time of lectures.** |
| **Course code** | **SIE104** |
| **Teacher's academic profile** | I am working at Salahaddin University-Erbil/ College of Engineering /Software and Informatics Engineering Department as an academic staff member since 2003 till now. During these years I taught the students many subjects from different stages. Depending of my experience I think the criteria of a good instructor (lecturer) must include the ability to communicate with the students to know more details about them, because sometimes there are some students suffering from either economic problems or social problems which may lead to Psychological effects. Also I try to use the modern teaching tools to deliver the knowledge to the students.  Finally, I believe that the Successful scientific march will be done, if there is cooperation between the lecturers and the students. |
| **Course overview:**  Discrete Mathematics is a mandatory requirement for a BSc in Software and Informatics Engineering. This course is an introduction to the mathematical study of discrete objects. In it, you will learn how to construct proofs, as well as read and write formal mathematics. The course covers Logic Statements and Proposition Algebra, Sets Theory and their operations, Relations and their Types, Functions, Graphs and their Types, Prime number, Trees and Formal Language and Machines.  Discrete Mathematics provides the mathematical foundations for many computer science and Software Engineering courses including Data Structures and Algorithms, Computational Theory, Compilers, Operating Systems, Database Systems, Data Security, to name a few. You will find these courses much more difficult if you attempt them without the foundations of discrete Mathematics. | |
| **Course objective:**  Our objective of this course is to build skills and give you experience in the following areas:   * Mathematical Reasoning: The ability to construct a sound logical argument is essential for computer scientists, not only because proofs are important in certain areas of computer science, but also because the same reasoning skills are used in both constructing proofs and in writing programs. * Combinatorial Analysis: An important problem solving skill is the ability to count or enumerate objects. It pops up surprisingly often in computer science applications. * Discrete Structures: These are the abstract mathematical structures used to represent discrete objects and relationships between those objects. Discrete structures include sets, permutations, relations, trees, graphs and finite-state machines. These structures form the conceptual basis for many of the data structures that we use as programmers. * Algorithmic Thinking: Certain classes of problems are solved by the specification of an algorithm that can be implemented in a program. The mathematical portions of this activity (which will interest us most) include the specification of the algorithm, the verification that it works properly, and the analysis of the computer memory and time required to perform it. * Applications and Modelling: Discrete math. Has applications to almost every conceivable area of study, including (of course) computer science, Software Engineering, chemistry, botany, zoology, linguistics, geography, business, etc. Modelling with discrete math. Is an extremely important problem solving skill. | |
| **Student's obligation**  **Attendance**  **Quizzes**  **Reports**  **Assignments** | |
| **Forms of teaching**  In the classroom, we will try the best to explain carefully the theoretical conceptual aspects of the subject, usually assuming that the students are familiar with a set of basic concepts on which the new material is based.  After that, some more lecturing time is devoted to showing, with as much detail as possible, the solution to the selected problems or exercises. In addition, I am available during some scheduled office hours to assist students with their personal work. | |
| **Assessment scheme**  Beside the final exam, which has 60 marks, the academic year consists of Midterm exam that has 20 marks; also we have 20 marks for the student’s activity. The total marks of the course will be like below:  Midterm exam: 20%  Student’s activity: 20%  **Average Marks: 40%**  **Final Exam: 60%** | |
| **Student learning outcome:**  At the end of this course, students will be able to:   * Identify proper models for discrete phenomena. * Recognize and construct logical arguments and proofs. * Solve enumeration problems. * Distinguish the properties of graph models. | |
| **Course Reading List and References‌:**   1. “Discrete Mathematics and Its Applications 7th Edition”, Kenneth H. Rosen, McGraw-Hill, 2012. 2. “Discrete Mathematics with Graph Theory 3rd Edition”, Edgar G. Goodaire and Michael M. Parmenter, 2006. | |
| **The Topics:**   |  |  | | --- | --- | | **Weeks** | **Descriptions** | | Week 1 | Introduction | | Weeks (2-3) | Logic Statements and Proposition Algebra | | Week 4 | Sets Theory and their operations | | Weeks (5-6) | Relations and their Types | | Weeks (7-8) | Functions | | Week 9 | Ring | | Week 10 | Graphs and their Types | | Weeks (11-12) | Trees | | Weeks (13-14) | Formal Language and Machines | | Week 15 | Number Theory | | |
| **Examinations:**  Q1: Construct the Truth table of the following Statement:    Solution:   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  | | T | T | T | F | F | T | T | | T | F | F | T | F | F | T | | F | T | T | F | T | T | T | | F | F | T | T | T | T | T |   Q2: Prove that  Solution:    Q3: Let A= {1,2,3}and R1,R2 and R3 are Relations defined on A as follows:  R1=  R2=  R3=  Show that above relations are Equivalence Relations or not?  Solution: test for reflexive, symmetric and transitive  About R1:    So that R1 is not Equivalence Relation, because it is Reflexive neither symmetric nor Transitive.  About R2:    So that R2 is not Equivalence Relation, because it is Transitive neither symmetric nor Reflexive.  About R3:    So that R3 is not Equivalence Relation, because it is Symmetric neither Transitive nor Reflexive.  Q4: From the Graph below:      c  a    b         1. Find the Order and the Size of the Graph. 2. Find Degree of the vertices a, b, c.   Solution:   1. The Order of the Graph= 3   The Size of the Graph=6   1. The Degree of the a can be calculated by:   In degree of a=2  Out degree of a=4  The Total degree of a=6  The Degree of the b can be calculated by:  In degree of b=1  Out degree of b=1  The Total degree of a=2  The Degree of the c can be calculated by:  In degree of c=3  Out degree of c=1  The Total degree of a=4  Q5: From the Following Data (18,100,6,5,50,12,14,70,45,120) Draw the Diagram of Ordered Binary Tree, and then use Postorder, Inorder and Preorder to Traversal the Tree.  Solution:  We take the digit 18 as a root, because we don’t give the root of the tree in the question.  18    100  6    120  50  12  5      70  45  14  The rule of the postorder is: Left Right Root (LRP)  5 14 12 6 45 70 50 120 100 18  Left Right Root  The rule of the Inorder is: Left Root Right (LPR)  5 6 12 14 18 45 50 70 100 120  Left Root Right  The rule of the preorder is: Root Left Right (PLR)  18 6 5 12 14 100 50 45 70 120  Root Left Right  Q6: Give the Language corresponding to the Grammar, where {S, A}, {a, b}.  P:      And then give the Type of the Grammar.  Solution:      The type of this grammar is Type3 Grammar or Regular Grammar. | |