FAST NUCES (KARACHI CAMPUS)

Department of Computer Science

Fall 2019 Semester

Bachelor of Science (Computer Science) Program

CS211 – Discrete Structures (3+0)

Course Instructors ***Mr. Shoaib Raza, Mr. Saif-Ul-Islam, and*** **Dr. Fahad Samad**
shoaib.raza@nu.edu.pk, muhammad.saif@nu.edu.pk, and fahad.samad@nu.edu.pk

Prerequisites **None**

Introduction

Discrete Structures deals with the study of mathematical structures that are fundamentally discrete rather than continuous. It is the mathematical language of computer science. It considers objects that vary in a discrete way. As computers are discrete object operating on discontinuous step at a time, Discrete Math is the right framework for describing precisely Computer Science concepts. It helps provide the mechanism necessary for creating sophisticated algorithms, the tools for analyzing their efficiency, and the means of proving their validity.

Course Objectives and Goals

A discrete mathematics course has more than one purpose. Students should learn a particular set of mathematical facts and how to apply them; more importantly, such a course should teach students how to think logically and mathematically. To achieve these goals, the focus of this course is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in algorithms and data structures. The focus is also on teaching the problem solving strategies, techniques, and tools and to show students how discrete mathematics can be used in modern computer science. In particular, this course is meant to introduce logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in Computer Science. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures.

Teaching Methodology & Requirements

Theory lectures, individual/group discussions, class activities, and consultation hours (office hours) are part of this course. Class meetings will NOT cover everything in the text. You have to solve a number of examples and exercises given in the text which are not covered in the class. All written assignments must be given to the instructor on or before the due dates. These assignments will not be accepted during the class lectures. All assignments that are not submitted on time will get a penalty of 50% of the total marks. You can always ask questions in class related to topic being presented, and are encouraged to take an active role in class participation. Please DO NOT EXPECT ANY RETAKE after a quiz has been conducted. Please arrive in and leave the class on time. Late arrivals and early departures disrupt class and disturb the instructor and the students.

Working together to solve homework problems is encouraged. You should learn from one another! However, the work you hand in should be your own. The "committee" approach to homework problem of dividing up the problem amongst your group and copying from your friends is cheating and will not be tolerated. A copied work will get you ZERO credit/mark. You learn by doing, so **do your own work yourself**.

Intended learning outcomes of the course (ILOs)

A) Knowledge and Understanding

Having successfully completed the course, the students should be able to demonstrate knowledge and understanding of:

- the fundamental concepts, notations, and terminologies in discrete mathematics
- introductory logic and techniques of formal proofs
- fundamental structures: Functions; relations; sets ; pigeonhole principle; cardinality and countability
- propositional logic and predicate logic
- basics of counting, the recurrence relations, proofs, mathematical induction and their applications
- problems involving graphs, paths, circuits, graph coloring, directed graphs, shortest path algorithms
- problems involving counting techniques such as permutations, combinations, binomial theorem, and probability.

B) Intellectual Skills

Having successfully completed the course, the students should be able to:

- explain the logics for fallacies, digital logics and programming logics
- describe how sets can be used to solve the problems in computer science by making programs
- solve the problems by using recursion and relations.
- express knowledge of the graphs used in computer network applications and graphic applications.

C) Professional Competencies

Having successfully completed the course, the students will be able to:

- write small logics behind programming and circuits
- identify the mathematical foundation and modeling behind the logics
- easily solve the probability beginning level questions
- model problems
- code your logic in programming languages

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Major Course Topics

- Logic and Proofs
- Sets and Functions
- Relations
- Number Theory
- Combinatorics and Recurrence Relations
- Graphs
- Trees
- Discrete Probability

Summarized Course Learning Outcomes

At the end of the course the students will be able to:	Domain	BT Level*
1. **Understand** the key concepts of Discrete Structures such as Sets, Permutations, Relations, Graphs, and Trees etc.	C	2
2. **Apply** formal logic proofs and/or informal, but rigorous, logical reasoning to real problems, such as predicting the behavior of software or solving problems such as puzzles.	C	3
3. **Apply** discrete structures into other computing problems such as formal specification, verification, databases, artificial intelligence, and cryptography.	C	3
4. **Differentiate** various discrete structures and their relevance within the context of computer science, in the areas of data structures and algorithms, in particular.	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Learning, Grading, and Class Attendance Learning will be accomplished through class lectures, book readings, students' participation in classroom quizzes and activities, and home assignments. Grading will tend to focus on your overall performance rather than on one or two aspects. Course grade will include the quizzes, class participation, home assignments, mid-semester exams, and end-semester exams. Students coming more than 10 minutes late to the class will be marked absent.

Assessment Instruments with Weights

Quizzes, Assignments, & Class Participation	20%
Mid-semester Examination I	15%
Mid-semester Examination II	15%
End-semester Examination (Final)	50%

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Textbook

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 8th Edition, McGraw Hill Education, 2019, ISBN: 978-1-259-67651-2

Reference Books

1. Sussana S. Epp, Discrete Mathematics with Applications, Brooks Cole, Cengage Learning, 5th Edition, 2019, ISBN: 978-0-357-03523-8
2. Richard Johnsonbaugh, Discrete Mathematics, Prentice Hall, 8th Edition, 2017, ISBN: 978-0-321-96468-7

Course Breakdown / Weekly Plan

Week #	Lecture #	Topics	No. of hours	Study Material
1	**1,2,3**	Introduction to Mathematical Reasoning and Propositional Logic	3	Text Book – Chapter 1 + Notes
2	**4,5,6**	Predicates and Quantifiers and Rules of Inference	3	Text Book – Chapter 1 + Notes
3	**7,8,9**	Sets and Functions	3	Text Book – Chapter 2 + Notes
4	**10,11,12**	Sequences and Series	3	Text Book – Chapter 2 + Notes
5	**13,14,15**	Relations	3	Text Book – Chapter 9 + Notes
6	**16,17,18**	Relations (contd.)	3	Text Book – Chapter 9 + Notes
7	**19,20,21**	Number Theory	3	Text Book – Chapter 4 + Notes
8	**22,23,24**	Mathematical Induction and Recursion	3	Text Book – Chapter 5 + Notes
9	**25,26,27**	Combinatorics: Permutation, and Combination	3	Text Book – Chapter 6 + Notes
10	**28,29,30**	Combinatorics: Permutation, and Combination	3	Text Book – Chapter 6 + Notes
11	**31,32,33**	Advanced Counting Techniques: Recurrence Relation	3	Text Book – Chapter 8 + Notes
12	**34,35,36**	Mathematical Proof s	3	Text Book – Chapter 1 + Notes

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Week #	Lecture #	Topics	No. of hours	Study Material
13	**37,38,39**	Graphs	3	Text Book – Chapter 10 + Notes
14	**40,41,42**	Graphs (contd.)	3	Text Book – Chapter 10 + Notes
15	**43,44,45**	Trees	3	Text Book – Chapter 11 + Notes
16	**46,47,48**	Discrete Probability	3	Text Book – Chapter 7 + Notes
17	**End-Semester Examination**			

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Dr. Fahad Samad (Course Instructor and Coordinator)