American University of Technology
Faculty of Applied Sciences
Computer Sciences
Fall 2019

Course Information (based on Course Catalogue)

Course No. MAT 204	Title: Discrete Math
Number of credits: 3	Number of contact hours per week: 3
Pre-requisites: none	Co-requisites: none
Description: 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, this course stresses mathematical reasoning and the different ways problems are solved. Five important themes are interwoven in this text: mathematical reasoning, combinatorial analysis, discrete structures, number theory and modeling. A successful discrete mathematics course should carefully blend and balance all five themes.	

Schedule Information (based on class schedule)

CRN :	Section :
Days/time class meets:	Class Location (Building & Room):
Name of Instructor: Dr. Mouhamad Ibrahim Telephone: - Email: Mouhamad.ibrahim@aut.edu Office location (if applicable): Administration building, second floor	

Course Learning Objectives

- *Mathematical Reasoning:* Students must understand mathematical reasoning in order to read, comprehend, and construct mathematical arguments.
- *Combinatorial Analysis:* An important problem-solving skill is the ability to count or enumerate objects. The discussion of enumeration in this book begins with the basic techniques of counting.
- *Discrete Structures:* A course in discrete mathematics should teach students how to work with discrete structures, which are the abstract mathematical structures used to represent discrete objects and relationships between these objects. These discrete structures include sets, permutations, relations, graphs, trees, and finite-state machines.
- *Boolean algebra:* Boolean algebra provides the operations and the rules for working with the set $\{0, 1\}$. Electronic and optical switches can be studied using this set and the rules of Boolean algebra. The three operations in Boolean algebra that we will use most are complementation, the Boolean sum, and the Boolean product.
- *Number Theory and Cryptography:* The part of mathematics devoted to the study of the set of integers and their properties is known as number theory. We will first introduce the notion of divisibility of integers, which we use to introduce modular, or clock, arithmetic. We will discuss base *b* representations of integers and give an algorithm for finding them. In particular, we will discuss binary, octal, and hexadecimal (base 2, 8, and 16) representations. We also introduce the subject of cryptography. Number theory plays an essentially role both in classical cryptography. We will show how the ideas we develop can be used in cryptographical protocols, introducing protocols for sharing keys and for sending signed messages.
- *Induction and Recursion:* Proofs using mathematical induction have two parts. First, they show that the statement holds for the positive integer 1. Second, they show that if the statement holds for a positive integer then it must also hold for the next larger integer. Mathematical induction is based on the rule of inference that tells us that if $P(1)$ and $\forall k(P(k) \rightarrow P(k+1))$ are true for the domain of positive integers, then $\forall n P(n)$ is true. To define functions, some initial terms are specified, and a rule is given for finding subsequent values from values already known. Such definitions, called *recursive definitions,* are used throughout discrete mathematics and computer science.
- *Counting:* Combinatorics, the study of arrangements of objects, is an important part of discrete mathematics. This subject was studied as long ago as the seventeenth century, when combinatorial questions arose in the study of gambling games. Enumeration, the counting of objects with certain properties, is an important part of combinatorics. We must count objects to solve many different types of problems. For instance, counting is used to determine the complexity of algorithms. Counting is also required to determine whether there are

enough telephone numbers or Internet protocol addresses to meet demand. Recently, it has played a key role in mathematical biology, especially in sequencing DNA. Furthermore, counting techniques are used extensively when probabilities of events are computed. The basic rules of counting, which we will study, can solve a tremendous variety of problems.

- *Discrete Probability:* The theory of probability was first developed more than 300 years ago, when certain gambling games were analyzed. Although probability theory was originally invented to study gambling, it now plays an essential role in a wide variety of disciplines.
- *Relations:* Relationships between elements of sets are represented using the structure called a relation, which is just a subset of the Cartesian product of the sets. Relations can be used to solve problems such as determining which pairs of cities are linked by airline flights in a network, finding a viable order for the different phases of a complicated project, or producing a useful way to store information in computer databases. We will study the representations of relations with Graphs.
- *Graphs:* are discrete structures consisting of vertices and edges that connect these vertices. There are different kinds of graphs, depending on whether edges have directions, whether multiple edges can connect the same pair of vertices, and whether loops are allowed. Problems in almost every conceivable discipline can be solved using graph models.
- *Trees:* A connected graph that contains no simple circuits is called a tree. Trees are particularly useful in computer science, where they are employed in a wide range of algorithms. Trees can be used to model procedures carried out using a sequence of decisions.

Course Design Components

Course Objectives	Assessment Activities	Learning Activities	Resources
1. *Mathematical Reasoning*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
2. *Combinatorial Analysis*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
3. *Discrete Structures*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
4. *Boolean algebra*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
5. *Number Theory and Cryptography*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
6. *Induction and Recursion*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
7. *Counting*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
8. *Discrete Probability*	**Defined in the Lectures notes**	**Exercises**	**TextBook**
9. Relations	**Defined in the Lectures notes**	**Exercises**	**TextBook**
10. Graphs	**Defined in the Lectures notes**	**Exercises**	**TextBook**
11. Trees	**Defined in the Lectures notes**	**Exercises**	**TextBook**

Course Schedule of Learning and Assessment Activities (based on academic calendar for both TTh, MWF, MW, or WF courses; dates will be provided to you as published by academic affairs office)

Weeks & Topics according to the course design above	**Mon**				**Fri**		

Course Graded Tasks/Assignments (All Assessment Activities)

1. Reading quizzes and Homework will make up (5+5)%
2. Reading quizzes are short examinations that can last up to 10 minutes. They consist of a few questions about the material covered in a previous class. No announcement for reading quizzes will be made and students are expected to daily study the covered material (this is the "Golden Rule" for successful studies). At least you have to expect at minimum 5 to10 RQ during the course.

Evaluation Criteria (Total must be equal to 100%)

Individual Performance Tasks/Exams: **60%**		
	- Exam 1 20% - Exam 2 20% - Exam 3 20% - Final Exam 30%	
	The Final Exam is a comprehensive exam based on a number of chapters of the course. Each Exam is based on 3 chapters studied during 3 weeks	

Required Textbooks

Kenneth H. Rosen and its Applications : 7th Edition
Mc Graw Hill

The book and the lectures are posted in Moodle

Supplemental References

< any additional references such as books, periodicals, or websites that are useful resources for the course>

Required Materials

None

Course Policies *(based on AUT policies and procedures as per Catalogue)*

Student Class Attendance Policy

"Students are expected to attend all classes and laboratory sessions on regular basis and on time. The maximum number of absence hours permitted in a course, whether authorized or not, is three (3) hours per credit. For example, a student is allowed to be absent up to 9 hours per semester in a 3-credit course without directly jeopardizing his/her grade in the course. If a student's number of absence hours in a course exceeds the maximum allowed limit then the student will automatically receive the failing grade ("FW") in the course. If a student wishes to withdraw from a class, the student must complete a "Course Withdrawal Form" and submit it to the Registrar Office before January 4, 2012. Otherwise, the student has not formally withdrawn from the class."

Academic Dishonesty (including Cheating and Plagiarism)

AUT endeavors to uphold Academic Integrity. Cheating, Plagiarism or other infractions will not be tolerated in this course. Read University policy on Plagiarism. Read class hand-outs on Plagiarism. Cheating and plagiarism is defined and addressed in several lectures. There is NO excuse for not knowing the policy. Lack of knowledge will not serve as an excuse. Hint: "recycling" your own work constitutes plagiarism.