Department of Mathematics and Computer Science
College of Science
University of the Philippines Baguio

Course Number: CMSC 55
Course Title: DISCRETE MATHEMATICAL STRUCTURES IN COMPUTER SCIENCE
Course Credit: 5 Units (5 Hours Lecture)
Prerequisite: None
Course Description: Principles of logic and set theory, combinatorics, discrete probability, recurrence, relations, graph theory, algebraic systems and their applications in computer science.

References/Suggested Readings:

- Discrete Mathematics (8th Edition), Richard Johnsonbaugh, 2017
- Discrete Mathematics: An Open Introduction, Oscar Levin, 2016
- Discrete Mathematics for Computer Science Preliminary Edition, David Liben-Nowell, 2015
- Mathematics of Discrete Structures for Computer Science, Gordon J. Pace, 2012
- Mathematical Structures for Computer Science, Judith L. Gersting, 2014
- Sets, Logic and Maths for Computing, David Makinson , 2012
- Discrete Mathematics and Applications (2nd Edition), Kevin Ferland, 2017

Course summary:

Computers cannot interpret mathematical values and functions as continuous values to how they were built and developed. This course will provide the students with a background on discrete mathematical structures and how it is applied to Computer Science.

Course Outcomes:
At the end of this course the student must be able to:

1. Discuss and identify the discrete mathematical structure concepts, given by:
   1.1. Logic and set theory
   1.2. Combinatorics
   1.3. Graph theory
   1.4. Algebraic systems
2. Understand the basic principles of sets and operations in sets
3. Prove basic set qualities
4. Apply counting principles to determine probabilities
5. Determine when a function is 1-1 and "onto"
6. Demonstrate an understanding of relations and functions and be able to determine their properties
7. Demonstrate different traversal methods for trees and graphs
8. Model problems in Computer Science using the concepts learned like graphs and trees

Learning Outcomes:

	Learning Output	Description and other Details
LO1	Project 1/ Problem Set 1	A problem set on logic and set theory
LO2	Project 2/ Problem Set 2	A problem set on combinatorics and graph theory
LO3	Project 3/ Problem Set 3	A programming project that models a Computer Science problem involving graphs and trees.

Course Outline:

1. Logic and Set Theory
   1.1 Propositional Logic
      1.1.1 Propositions
      1.1.2 Logical Connectives

- 1.1.3 Rules of Inference
- 1.1.4 Laws of Equivalence
- 1.1.5 Proof Techniques
  - 1.1.5.1 Truth Tables
  - 1.1.5.2 Chain of Reasoning
  - 1.1.5.3 Chain of Equivalence
  - 1.1.5.4 Proof by Contradiction
  - 1.1.5.5 Resolution

1.2 Set Theory
- 1.2.1 Sets and Set Operations
- 1.2.2 Algebra of Sets
- 1.2.3 Relations
- 1.2.4 Ordering Relations
- 1.2.5 Equivalence Relations
- 1.2.6 Partitions
- 1.2.7 Functions
- 1.2.8 Composition and Inversion of Functions

1.3 Predicate Logic
- 1.3.1 Predicates and Quantifiers
- *1.3.2* Proving Validity

1.4 Boolean Algebra and Switching Algebra

1.5 Mathematical Induction

2. Combinatorics

2.1 Elementary Combinatorics
- 2.1.1 Rules of Sum and Product
- 2.1.2 Two Models of counting
- 2.1.3 Combinatorial Identities
- 2.1.4 Generating Functions
- 2.1.5 Recurrence Relations
- 2.1.6 Inclusion-Exclusion Principle

2.2 Discrete Probability
- 2.2.1 Axioms of the Theory of Probability
- 2.2.2 Finite Sample Spaces and Sampling
- 2.2.3 Conditional Probability and Independent Events
- 2.2.4 Random Variables and Discrete Distributions

3 Graph Theory

3.1 Types of Graphs

3.2 Some Graph Problems and Applications
- 3.2.1 Isomorphism and Homomorphism
- 3.2.2 Planarity
- 3.2.3 Shortest Path
- 3.2.4 Minimum Spanning Tree
- 3.2.5 Travelling Salesman
- 3.2.6 Matching
- 3.2.7 Colorability

3.3 Finite State Machines and Languages

3.4 Trees and Languages

4 Algebraic Systems

4.1 Algebraic Structures

4.2 Groups, Groupoids and Semigroups

4.3 Homomorphism and Isomorphism

4.4 Application in Coding Theory

Course Requirements:

3 Long Exams	
Projects/Problem Sets	
Class Exercises	
Quizzes, Seatworks, etc.	
Final Exam	
TOTAL	100%

Course Policies:

1. Regular attendance and class participation are required. **A STUDENT WHO IS ABSENT FOR MORE THAN SIX (6) TIMES AND HAS FAILED TO DROP THE COURSE ON THE DROPPING DATE WILL BE GIVEN A GRADE OF 5.0.**
2. **THERE WILL BE NO SPECIAL LONG EXAM FOR ANY LONG EXAM MISSED UNLESS THERE IS A VALID REASON (DOCUMENTATION REQUIRED). YOU ARE ONLY ALLOWED TO MISS ONE LONG EXAM. SCORE FOR THAT MISSED EXAM WILL BE TAKEN FROM THE SCORE GARNERED FROM THE FINAL EXAM (DOUBLE-THE-FINAL). OTHER EXAMS MISSED WILL BE GIVEN A RAW SCORE OF 0 POINTS.**
3. **STUDENTS MUST TAKE THE FINAL EXAM OR A GRADE OF "INC" WILL BE INCURRED.**
4. The projects/problem sets are intended to help the student apply the concepts learned in class to realistic situations and in a realistic computing environment.
   The student is expected to do his/her own work. Each one may discuss project concepts with classmates but do not discuss specific details nor do any joint work resulting in code. **No exchanges of programming codes, either in pieces or in entirety, by any means. These are forms of cheating and will be sanctioned accordingly. CHEATING WILL NOT BE TOLERATED. AN AUTOMATIC GRADE OF 5.0 WILL BE GIVEN TO ANY STUDENT CAUGHT CHEATING.**
5. On programming projects/problem sets, **the grade will be reduced by 10% of the total score for every day late submission**. Deductions will continue to accrue until the project is finally submitted. On the other hand, early submissions will be given an (10% of the score earned) x no. of days earlier than the deadline date (no more than 30%).
6. **ALL PROJECTS/PROBLEM SETS MUST BE PASSED OR A GRADE OF "INC" WILL BE INCURRED.**
7. In order to qualify for exemption in taking the final exam, the student must satisfy all of the following:
   - Must have an average of 85% or better from his/her long exams, and no failed/missed exam;
   - Must have a current standing (partial) of 60% or better, prior to final examination week.
8. No make-up machine exercise/quiz will be given.
9. Complaints regarding long exams and MP results will be entertained only up to one week after its release.