

## Course Outline

Course Title: Discrete Mathematics

Common Course Title: MAD2104

Effective Term: Fall 2020 ( Aug 7, 2020 )

Credit Hours: 3 Units

Next Review : Aug 8, 2028

Contact Hour Breakdown: *(Per 16 week Term)*

Total: 48

Lecture:

Lab:

Clinic:

Other:

## Requirements

Pre-requisite(s) with minimum grade required

MAC1140 (C) OR MAC1147 (C) OR MAC2311 (C) OR MAC2312 (C) OR MAC2313 (C)

## Course Description:

This course will emphasize mathematical theory, formal methods of proof, and applied problem- solving techniques. Topics include formal proof, sets, logic, functions, probability, relations, graphs, trees, and Boolean algebra.

## Course Outline

### UNITS

#### **Unit 1 : Introductory Set Theory**

##### General Outcome

1.0 Understand sets, prove various theorems about sets, and solve problems involving sets.

##### Specific Learning Outcomes

- 1.1 Determine the complement of a given set.
- 1.2 Identify subsets of a given set and use subsets to prove set equality.
- 1.3 Perform set operations: intersection, union, difference, and Cartesian product.
- 1.4 Interpret and apply Venn diagrams to solve problems and determine relationships among sets.
- 1.5 Identify set equivalences and apply DeMorgan's Laws for sets.
- 1.6 Determine the cardinal number of a set.

#### **Unit 2 : Formal Logic**

##### General Outcome

2.0 Understand formal logic, prove various theorems about logic, and solve problems involving logic.

##### Specific Learning Outcomes

- 2.1 Determine whether or not a sentence is a logical proposition and find the negation.
- 2.2 Identify conjunctions, disjunctions, Conditional and biconditional propositions and determine their truth values.
- 2.3 Identify quantified statements and find the negation of a quantified statement.
- 2.4 Construct truth tables for a logical statement and a logical argument.
- 2.5 Identify logical equivalences and apply DeMorgan's Laws for logic.
- 2.6 Identify the validity of a formal logical argument using both truth tables and rules of inference.
- 2.7 Perform calculations related to Boolean algebra.

### **Unit 3 : Methods of Proof**

#### General Outcome

3.0 Understand various methods of proof and be able to construct formal proofs.

#### Specific Learning Outcomes

- 3.1 Use mathematical induction to prove a given statement.
- 3.2 Use a direct proof to verify a given statement.
- 3.3 Use proof by contraposition to verify a given statement.
- 3.4 Utilize proof by contradiction to verify a given statement.
- 3.5 Use a counter-example to disprove a statement.

### **Unit 4 : Functions and Relations**

#### General Outcome

4.0 Understand functions and relations and their properties. Solve problems involving functions and relations and complete proofs of various properties of functions and relations.

#### Specific Learning Outcomes

- 4.1 Identify a function by definition and classify relations as functions or not.
- 4.2 Distinguish between discrete functions and continuous functions.
- 4.3 Identify the domain, range, and codomain of a given function.
- 4.4 Classify a function as an injection, surjection, or bijection.
- 4.5 Compute the inverse of a function and understand the properties of an inverse function.
- 4.6 Create the composition of functions and understand the properties of the composition.
- 4.7 Identify some important functions and their properties. These functions may include step functions, piecewise functions, and other miscellaneous discrete mappings.
- 4.8 Demonstrate knowledge of the definition of a relation and associated properties.
- 4.9 Represent relations with graphs.
- 4.10 Identify equivalence relations.

### **Unit 5 : Counting and Probability**

#### General Outcome

5.0 Solve counting problems and use counting to find probabilities. Understand discrete and continuous distributions and be able to prove some basic results.

#### Specific Learning Outcomes

- 5.1 Create a tree diagram for a sample space.
- 5.2 Understand the pigeonhole principle and use it to solve counting problems.
- 5.3 Use the Fundamental Counting Principle to solve counting problems.
- 5.4 Apply combinations and permutations to solve counting problems.
- 5.5 Demonstrate understanding of and solve problems related to discrete probability distributions.
- 5.6 Solve counting and probability problems involving independent events, conjunctive statements and conditional probability.
- 5.7 Apply binomial coefficients to probability.
- 5.8 Compute expected value and variance and prove some basic results using these concepts.
- 5.9 Use Bayes' Theorem to solve problems.

### **Unit 6 : Graphs and Trees**

General Outcome

6.0 Understand basic terminology of graphs and digraphs, paths, and circuits. Represent graphs using matrices and tables and write algorithms for searching graphs. Use graphs and trees to solve problems.

Specific Learning Outcomes

- 6.1 Identify the definitions of graphs and trees.
- 6.2 Identify graph terminology and graph properties.
- 6.3 Construct graph isomorphisms.
- 6.4 Solve connectivity and shortest path problems.
- 6.5 Identify Euler and Hamiltonian paths and circuits.
- 6.6 Identify planar graphs and graph coloring schemes.
- 6.7 Solve tree-traversal problems.
- 6.8 Exhibit spanning trees.