MTH 172 TECHNICAL DISCRETE MATHEMATICS – Course Objectives

Throughout the course, there will be an emphasis on the development of technical discrete mathematics skills, rather than rigorous proof. Computer related applications will be integrated throughout the course when appropriate.

1. Number Systems

- 1.1 Convert a decimal number to a binary, octal, or hexadecimal number.
- 1.2 Convert a binary, octal, or hexadecimal number to a decimal number.
- 1.3 Perform basic arithmetic operations on binary, octal, and hexadecimal numbers.
- 1.4 Apply the Division Algorithm and the Euclidean Algorithm.
- 1.5 Perform modular arithmetic and determine if two integers are congruent for a given modulus.
- 1.6 Solve linear congruences.

2. Sets

- 2.1 Use set builder notation to describe a given set, and be able to list the elements of a set described using set builder notation.
- 2.2 Determine if one set is a subset of another set, and find the power set of a given set. Use standard notations for subsets and power sets.
- 2.3 Find the intersection and union of two given sets, and find the complement of a given set. Use standard notations for intersections, unions, and complements.
- 2.4 Use Venn Diagrams to determine whether a proposed set identity is true or false.

3. Logic

- 3.1 Write English sentences for logical expressions and vice-versa. Use standard notations of logic.
- 3.2 Construct truth tables for expressions involving the following logical connectives: negation, conjunction, disjunction, conditional, and biconditional.
- 3.3 Determine if two logical expressions are or are not logically equivalent.
- 3.4 Determine if a logical expression is a tautology, contradiction, or neither.
- 3.5 Determine if a logical argument is valid or invalid, either by using truth tables or by applying standard rules of inference.
- 3.6 Given a set of premises, be able to apply standard rules of inference to deduce a valid conclusion.

4. Mathematical Induction

- 4.1 Use sigma notation to represent finite sums, and evaluate finite sums given in sigma notation.
- 4.2 Use the Principle of Mathematical Induction to show that a proposed summation formula is true.

5. Combinatorics

- 5.1 Count the number of permutations that can be formed from a given collection of objects. Use factorial and nPr notation to express such quantities.
- 5.2 Count the number of combinations that can be formed with r elements chosen from a set of n elements. Use $\binom{n}{r}$ and/or nCr notation to express such quantities.
- 5.3 Use the Addition and Multiplication Rules to solve counting problems involving permutations and combinations.
- 5.4 Use the Binomial Theorem to expand a positive integer power of a binomial and to identify the coefficient of a specified term.

Created: 6/05

6. Relations and Functions

6.1 Write the Cartesian product of two sets as a collection of ordered pairs.
6.2 Identify the domain and range of a given relation and draw an arrow diagram to represent a given relation.
6.3 Determine if a given relation is an equivalence relation.
6.4 Determine if a given relation defines a function.
6.5 Evaluate a variety of functions including functions of multiple variables, recursively defined functions, and functions whose domain and/or range do not consist of numbers.
6.6 Find the sum, difference, product, quotient, and composition of two functions.
6.7 Determine if a given function is one-to-one and/or onto and find the inverse of a bijective function.
6.8 Use big-O to compare the growth rates of polynomial, logarithmic, and exponential expressions.
6.9 Apply the concept of big-O to analyze and compare the efficiency of simple algorithms.

7. Vectors and Matrices

7.1 Use a matrix to organize or interpret a collection of data.
7.2 Determine the dimensions of a given matrix.
7.3 Use subscript notation to indicate and/or define entries of a matrix.
7.4 Add and subtract matrices of equal dimension. Multiply a matrix by a scalar and multiply two matrices or determine that a given product is undefined.
7.5 Write the augmented matrix for a system of up to three linear equations in three unknowns and use row-reduction to solve the system.

8. Boolean Algebra

8.1 State and use the axioms of a Boolean algebra.
8.2 Carry out operations within a Boolean algebra.
8.3 Determine if two Boolean expressions are equivalent.
8.4 Find the dual of a statement in a Boolean algebra.
8.5 Obtain the complete sum-of-products and the complete product-of-sums form for a Boolean function or expression.