Discrete Mathematics Honors

Version Description

In Discrete Mathematics Honors, instructional time will emphasize six areas:

(1) extending understanding of sequences and patterns to include Fibonacci sequences and tessellations;
(2) applying probability and combinatorics;
(3) extending understanding of systems of equations and inequalities to solve linear programming problems;
(4) developing an understanding of Graph Theory, Election Theory and Set Theory and
(5) developing an understanding of propositional logic, arguments and methods of proof.

Curricular content for all subjects must integrate critical-thinking, problem-solving, and workforce-literacy skills; communication, reading, and writing skills; mathematics skills; collaboration skills; contextual and applied-learning skills; technology-literacy skills; information and media-literacy skills; and civic-engagement skills.

All clarifications stated, whether general or specific to Discrete Mathematics Honors, are expectations for instruction of that benchmark.

General Notes

Honors and Accelerated Level Course Note: Accelerated courses require a greater demand on students through increased academic rigor. Academic rigor is obtained through the application, analysis, evaluation, and creation of complex ideas that are often abstract and multi-faceted. Students are challenged to think and collaborate critically on the content they are learning. Honors level rigor will be achieved by increasing text complexity through text selection, focus on high-level qualitative measures, and complexity of task. Instruction will be structured to give students a deeper understanding of conceptual themes and organization within and across disciplines. Academic rigor is more than simply assigning to students a greater quantity of work.

Florida's Benchmarks for Excellent Student Thinking (B.E.S.T.) Standards: This course includes Florida's B.E.S.T. ELA Expectations (EE) and Mathematical Thinking and Reasoning Standards (MTRs) for students. Florida educators should intentionally embed these standards within the content and their instruction as applicable. For guidance on the implementation of the EEs and MTRs, please visit https://www.cpalms.org/Standards/BEST_Standards.aspx and select the appropriate B.E.S.T. Standards package.

English Language Development ELD Standards Special Notes Section: Teachers are required to provide listening, speaking, reading and writing instruction that allows English language learners (ELL) to communicate information, ideas and concepts for academic success in the content area of Mathematics. For the given level of English language proficiency and with visual, graphic, or interactive support, students will interact with grade level words, expressions, sentences and discourse to process or produce language necessary for academic success. The ELD standard should specify a relevant content area concept or topic of study chosen by curriculum developers

and teachers which maximizes an ELL's need for communication and social skills. To access an ELL supporting document which delineates performance definitions and descriptors, please click on the following link: https://cpalmsmediaprod.blob.core.windows.net/uploads/docs/standards/eld/ma.pdf.

General Information

Course Number: 1212300	Course Type: Core Academic Course
Course Length: Year (Y)	Course Level: 3
Course Attributes: Honors	Grade Level(s): 9, 10, 11, 12
Graduation Requirement: Mathematics	Number of Credits: One (1) credit
Course Path: Section | Grades PreK to 12 Education Courses > Grade Group | Grades 9 to 12 and Adult Education Courses > Subject | Mathematics > SubSubject | Discrete Mathematics > Abbreviated Title | DISCRETE MATH HONORS	
Educator Certification: Mathematics (Grades 6-12)	

Course Standards and Benchmarks

Mathematical Thinking and Reasoning

MA.K12.MTR.1.1 Actively participate in effortful learning both individually and collectively.

Mathematicians who participate in effortful learning both individually and with others:

- Analyze the problem in a way that makes sense given the task.
- Ask questions that will help with solving the task.
- Build perseverance by modifying methods as needed while solving a challenging task.
- Stay engaged and maintain a positive mindset when working to solve tasks.
- Help and support each other when attempting a new method or approach.

Clarifications:

Teachers who encourage students to participate actively in effortful learning both individually and with others:

- Cultivate a community of growth mindset learners.
- Foster perseverance in students by choosing tasks that are challenging.
- Develop students' ability to analyze and problem solve.
- Recognize students' effort when solving challenging problems.

MA.K12.MTR.2.1 Demonstrate understanding by representing problems in multiple ways.

Mathematicians who demonstrate understanding by representing problems in multiple ways:

- Build understanding through modeling and using manipulatives.
- Represent solutions to problems in multiple ways using objects, drawings, tables, graphs and equations.
- Progress from modeling problems with objects and drawings to using algorithms and equations.
- Express connections between concepts and representations.
- Choose a representation based on the given context or purpose.

Clarifications:

Teachers who encourage students to demonstrate understanding by representing problems in multiple ways:

- Help students make connections between concepts and representations.
- Provide opportunities for students to use manipulatives when investigating concepts.
- Guide students from concrete to pictorial to abstract representations as understanding progresses.
- Show students that various representations can have different purposes and can be useful in different situations.

MA.K12.MTR.3.1 Complete tasks with mathematical fluency.

Mathematicians who complete tasks with mathematical fluency:

- Select efficient and appropriate methods for solving problems within the given context.
- Maintain flexibility and accuracy while performing procedures and mental calculations.
- Complete tasks accurately and with confidence.
- Adapt procedures to apply them to a new context.
- Use feedback to improve efficiency when performing calculations.

Clarifications:

Teachers who encourage students to complete tasks with mathematical fluency:

- Provide students with the flexibility to solve problems by selecting a procedure that allows them to solve efficiently and accurately.
- Offer multiple opportunities for students to practice efficient and generalizable methods.
- Provide opportunities for students to reflect on the method they used and determine if a more efficient method could have been used.

MA.K12.MTR.4.1 Engage in discussions that reflect on the mathematical thinking of self and others.

Mathematicians who engage in discussions that reflect on the mathematical thinking of self and others:

- Communicate mathematical ideas, vocabulary and methods effectively.
- Analyze the mathematical thinking of others.
- Compare the efficiency of a method to those expressed by others.
- Recognize errors and suggest how to correctly solve the task.
- Justify results by explaining methods and processes.
- Construct possible arguments based on evidence.

Clarifications:
Teachers who encourage students to engage in discussions that reflect on the mathematical thinking of self and others:

- Establish a culture in which students ask questions of the teacher and their peers, and error is an opportunity for learning.
- Create opportunities for students to discuss their thinking with peers.
- Select, sequence and present student work to advance and deepen understanding of correct and increasingly efficient methods.
- Develop students' ability to justify methods and compare their responses to the responses of their peers.

MA.K12.MTR.5.1 Use patterns and structure to help understand and connect mathematical concepts.

Mathematicians who use patterns and structure to help understand and connect mathematical concepts:

- Focus on relevant details within a problem.
- Create plans and procedures to logically order events, steps or ideas to solve problems.
- Decompose a complex problem into manageable parts.
- Relate previously learned concepts to new concepts.
- Look for similarities among problems.
- Connect solutions of problems to more complicated large-scale situations.

Clarifications:
Teachers who encourage students to use patterns and structure to help understand and connect mathematical concepts:

- Help students recognize the patterns in the world around them and connect these patterns to mathematical concepts.
- Support students to develop generalizations based on the similarities found among problems.
- Provide opportunities for students to create plans and procedures to solve problems.
- Develop students' ability to construct relationships between their current understanding and more sophisticated ways of thinking.

MA.K12.MTR.6.1 Assess the reasonableness of solutions.

Mathematicians who assess the reasonableness of solutions:

- Estimate to discover possible solutions.
- Use benchmark quantities to determine if a solution makes sense.
- Check calculations when solving problems.
- Verify possible solutions by explaining the methods used.
- Evaluate results based on the given context.

Clarifications:

Teachers who encourage students to assess the reasonableness of solutions:

- Have students estimate or predict solutions prior to solving.
- Prompt students to continually ask, "Does this solution make sense? How do you know?"
- Reinforce that students check their work as they progress within and after a task.
- Strengthen students' ability to verify solutions through justifications.

MA.K12.MTR.7.1 Apply mathematics to real-world contexts.

Mathematicians who apply mathematics to real-world contexts:

- Connect mathematical concepts to everyday experiences.
- Use models and methods to understand, represent and solve problems.
- Perform investigations to gather data or determine if a method is appropriate.
- Redesign models and methods to improve accuracy or efficiency.

Clarifications:

Teachers who encourage students to apply mathematics to real-world contexts:

- Provide opportunities for students to create models, both concrete and abstract, and perform investigations.
- Challenge students to question the accuracy of their models and methods.
- Support students as they validate conclusions by comparing them to the given situation.
- Indicate how various concepts can be applied to other disciplines.

ELA Expectations

ELA.K12.EE.1.1 Cite evidence to explain and justify reasoning.

ELA.K12.EE.2.1 Read and comprehend grade-level complex texts proficiently.

ELA.K12.EE.3.1 Make inferences to support comprehension.

ELA.K12.EE.4.1 Use appropriate collaborative techniques and active listening skills when engaging in discussions in a variety of situations.

ELA.K12.EE.5.1 Use the accepted rules governing a specific format to create quality work.

ELA.K12.EE.6.1 Use appropriate voice and tone when speaking or writing.

English Language Development

ELD.K12.ELL.MA Language of Mathematics

ELD.K12.ELL.MA.1	English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics.

Algebraic Reasoning

MA.912.AR.9 Write and solve a system of two- and three-variable equations and inequalities that describe quantities or relationships.

MA.912.AR.9.6	Given a real-world context, represent constraints as systems of linear equations or inequalities. Interpret solutions to problems as viable or non-viable options.

Benchmark Clarifications:
Clarification 1: Instruction focuses on analyzing a given function that models a real-world situation and writing constraints that are represented as linear equations or linear inequalities.

MA.912.AR.9.8	Solve real-world problems involving linear programming in two variables.

MA.912.AR.10 Solve problems involving sequences and series.

MA.912.AR.10.1	Given a mathematical or real-world context, write and solve problems involving arithmetic sequences. *Example:* Tara is saving money to move out of her parent's house. She opens the account with $250 and puts $100 into a savings account every month after that. Write the total amount of money she has in her account after each month as a sequence. In how many months will she have at least $3,000?

MA.912.AR.10.2	Given a mathematical or real-world context, write and solve problems involving geometric sequences. *Example:* A bacteria in a Petri dish initially covers 2 square centimeters. The bacteria grows at a rate of 2.6% every day. Determine the geometric sequence that describes the area covered by the bacteria after $0, 1, 2, 3$ ... days. Determine using technology, how many days it would take the bacteria to cover 10 square centimeters.
MA.912.AR.10.5	Given a mathematical or real-world context, write a sequence using function notation, defined explicitly or recursively, to represent relationships between quantities from a written description.
MA.912.AR.10.6	Given a mathematical or real-world context, find the domain of a given sequence defined recursively or explicitly.

Geometric Reasoning

MA.912.GR.2 Apply properties of transformations to describe congruence or similarity.

MA.912.GR.2.4	Determine symmetries of reflection, symmetries of rotation and symmetries of translation of a geometric figure.

Benchmark Clarifications:
Clarification 1: Instruction includes determining the order of each symmetry.
Clarification 2: Instruction includes the connection between tessellations of the plane and symmetries of translations.

Data Analysis and Probability

MA.912.DP.4 Use and interpret independence and probability.

MA.912.DP.4.1	Describe events as subsets of a sample space using characteristics, or categories, of the outcomes, or as unions, intersections or complements of other events.
MA.912.DP.4.9	Apply the addition and multiplication rules for counting to solve mathematical and real-world problems, including problems involving probability.

MA.912.DP.4.10 Given a mathematical or real-world situation, calculate the appropriate permutation or combination.

Logic and Discrete Theory

MA.912.LT.1 Apply recursive methods to solve problems.

MA.912.LT.1.1 Apply recursive and iterative thinking to solve problems.

MA.912.LT.1.2 Solve problems involving recurrence relations.

Benchmark Clarifications:
Clarification 1: Instruction includes finding explicit or recursive equations for recursively defined sequences.
Clarification 2: Problems include fractals, the Fibonacci sequence, growth models and finite difference.

MA.912.LT.2 Apply optimization and techniques from Graph Theory to solve problems.

MA.912.LT.2.1 Define and explain the basic concepts of Graph Theory.

Benchmark Clarifications:
Clarification 1: Basic concepts include vertex, edge, directed edge, undirected edge, path, vertex degree, directed graph, undirected graph, tree, bipartite graph, circuit, connectedness and planarity.

MA.912.LT.2.2 Solve problems involving paths in graphs.

Benchmark Clarifications:
Clarification 1: Instruction includes simple paths and circuits; Hamiltonian paths and circuits; and Eulerian paths and circuits.

MA.912.LT.2.3 Solve scheduling problems using critical path analysis and Gantt charts. Create a schedule using critical path analysis.

MA.912.LT.2.4 Apply graph coloring techniques to solve problems.

Benchmark Clarifications:
Clarification 1: Problems include map coloring and committee assignments.

MA.912.LT.2.5	Apply spanning trees, rooted trees, binary trees and decision trees to solve problems.

Benchmark Clarifications:
Clarification 1: Instruction includes the use of technology to determine the number of possible solutions and generating solutions when a feasible number of possible solutions exists.

MA.912.LT.3	***Apply techniques from Election Theory and Fair Division Theory to solve problems.***
MA.912.LT.3.1	Define and explain the basic concepts of Election Theory and voting.

Benchmark Clarifications:
Clarification 1: Basic concepts include approval and preference voting, plurality, majority, runoff, sequential runoff, Borda count, Condorcet and other fairness criteria, dummy voters and coalition.

MA.912.LT.3.2	Analyze election data using election theory techniques. Explain how Arrow's Impossibility Theorem may be related to the fairness of the outcome of the election.
MA.912.LT.3.3	Decide voting power within a group using weighted voting techniques. Provide real-world examples of weighted voting and its pros and cons.
MA.912.LT.3.4	Solve problems using fair division and apportionment techniques.

Benchmark Clarifications:
Clarification 1: Problems include fair division among people with different preferences, fairly dividing an inheritance that includes indivisible goods, salary caps in sports and allocation of representatives to Congress.

MA.912.LT.4	***Develop an understanding of the fundamentals of propositional logic, arguments and methods of proof.***
MA.912.LT.4.1	Translate propositional statements into logical arguments using propositional variables and logical connectives.
MA.912.LT.4.2	Determine truth values of simple and compound statements using truth tables.

MA.912.LT.4.3	Identify and accurately interpret "if…then," "if and only if," "all" and "not" statements. Find the converse, inverse and contrapositive of a statement.

Benchmark Clarifications:
Clarification 1: Instruction focuses on recognizing the relationships between an "if…then" statement and the converse, inverse and contrapositive of that statement.
Clarification 2: Within the Geometry course, instruction focuses on the connection to proofs within the course.

MA.912.LT.4.4	Represent logic operations, such as AND, OR, NOT, NOR, and XOR, using logical symbolism to solve problems.
MA.912.LT.4.5	Determine whether two propositions are logically equivalent.
MA.912.LT.4.6	Apply methods of direct and indirect proof and determine whether a logical argument is valid.
MA.912.LT.4.7	Identify and give examples of undefined terms; axioms; theorems; proofs, including proofs using mathematical induction; and inductive and deductive reasoning.
MA.912.LT.4.8	Construct proofs, including proofs by contradiction.

Benchmark Clarifications:
Clarification 1: Within the Geometry course, proofs are limited to geometric statements within the course.

MA.912.LT.4.9	Construct logical arguments using laws of detachment, syllogism, tautology, contradiction and Euler Diagrams.
MA.912.LT.4.10	Judge the validity of arguments and give counterexamples to disprove statements.

Benchmark Clarifications:
Clarification 1: Within the Geometry course, instruction focuses on the connection to proofs within the course.

MA.912.LT.5 Apply properties from Set Theory to solve problems.

MA.912.LT.5.1	Given two sets, determine whether the two sets are equivalent and whether one set is a subset of another. Given one set, determine its power set.

MA.912.LT.5.2	Given a relation on two sets, determine whether the relation is a function, determine the inverse of the relation if it exists and identify if the relation is bijective.
MA.912.LT.5.3	Partition a set into disjoint subsets and determine an equivalence class given the equivalence relation on a set.
MA.912.LT.5.4	Perform the set operations of taking the complement of a set and the union, intersection, difference and product of two sets.

Benchmark Clarifications:
Clarification 1: Instruction includes the connection to probability and the words AND, OR and NOT.

MA.912.LT.5.5	Explore relationships and patterns and make arguments about relationships between sets by using Venn Diagrams.
MA.912.LT.5.6	Prove set relations, including DeMorgan's Laws and equivalence relations.