

**Course Title:** Applied Discrete Mathematics

**Topic/Concept:** Graph theory

**Time Allotment:** 7 weeks

**Unit Sequence:** 1

**Major Concepts to be learned:**

1. Euler circuits are used when all edges must be covered
2. Hamiltonian circuits are used when all vertices must be visited
3. Optimal solutions to many graph theory problems cannot always be guaranteed

**Expected Skills to be demonstrated:**

1. Construct a graph that models a problem
2. "Eulerize" a graphApply various algorithms to Chinese Postman
3. Traveling Saleman problemsUse Kruskal's algorithm to find minimum-cost spanning treesUse order-requirement digraphs to model and solve scheduling problems

**PA Standards/Anchors:**

**Eligible Content:**

N/A

N/A

**Instructional Strategies:**

**Assessments:**

Coooperative groups  
Problem solving activities  
Lecture  
Group discussion  
Performance task

- Tests
- Projects

**Course Title:** Applied Discrete Mathematics

**Topic/Concept:** Scheduling

**Time Allotment:** 4 weeks

**Unit Sequence:** 2

**Major Concepts to be learned:**

1. Optimal solutions to scheduling problems cannot always be guaranteed
2. Different algorithms can produce widely varying solutions to scheduling problems
3. Changing the scheduling problem assumptions can produce counterintuitive outcomes

**Expected Skills to be demonstrated:**

1. Apply the list-processing algorithm to machine scheduling problems
2. Apply the critical path scheduling algorithm to machine scheduling problems
3. Apply the decreasing time list algorithm to machine scheduling problems
4. Solve bin packing problems using various heuristic algorithms
5. Resolve scheduling conflicts using graph coloring

**PA Standards/Anchors:**

**Eligible Content:**

N/A	N/A
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**Instructional Strategies:**

**Assessments:**

Coooperative groups Problem solving activities Lecture Group discussion Performance task	<ul style="list-style-type: none"><li>• Tests</li><li>• Projects</li></ul>
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**Course Title:** Applied Discrete Mathematics

**Topic/Concept:** Social choice

**Time Allotment:** 4 weeks

**Unit Sequence:** 3

**Major Concepts to be learned:**

1. May's Theorem
2. The Condorcet Winner Criterion
3. Arrow's Impossibility Theorem

**Expected Skills to be demonstrated:**

1. Apply various voting methods, such as plurality, Condorcet's method, Borda count, sequential pairwise voting, the Hare system, and approval voting, to provide social choice
2. Evaluate various voting methods against several criteria including the Condorcet Winner Criteria, independence of irrelevant alternatives, the Pareto condition, and monotonicity.

**PA Standards/Anchors:**

**Eligible Content:**

N/A	N/A
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**Instructional Strategies:**

**Assessments:**

Coooperative groups Problem solving activities Lecture Group discussion Performance task	<ul style="list-style-type: none"><li>• Tests</li><li>• Projects</li></ul>
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Course Title: Applied Discrete Mathematics

Topic/Concept: Game theory

Time Allotment: 4 weeks

Unit Sequence: 4

**Major Concepts to be learned:**

1. Nash equilibria
2. Prisoners' dilemma
3. The value of a game

**Expected Skills to be demonstrated:**

1. Find the value of a two-person, total conflict game involving pure and mixed strategies
2. Find dominant strategies and Nash equilibria in two-person, partial conflict games
3. Use game trees to solve truels

**PA Standards/Anchors:**

**Eligible Content:**

N/A

N/A

**Instructional Strategies:**

**Assessments:**

Cooperative groups  
Problem solving activities  
Lecture  
Group discussion  
Performance task

- Tests

Course Title: Applied Discrete Mathematics

Topic/Concept: The Digital World

Time Allotment: 10 weeks

Unit Sequence: 5

**Major Concepts to be learned:**

1. The choice of base in a number system is made for convenience
2. The purely academic pursuits of number theorists have found important applications in our modern, digital world

**Expected Skills to be demonstrated:**

1. Use modular arithmetic to calculate a check digit for an ISBN or other similar number
2. Encode digital messages using parity check sums
3. Use the nearest neighbor algorithm to decode a digital code word
4. Develop a Huffman coding scheme for compression of digital information
5. Use Caesar, decimation, and Vigenere ciphers to encrypt and decrypt messages
6. Use the RSA public key cryptosystem to encrypt and decrypt messages
7. Develop truth tables for Boolean expressions
8. Determine whether or not two Boolean expressions are logically equivalent
9. Determine the network address of an internet protocol address given the subnet mask

**PA Standards/Anchors:**

**Eligible Content:**

N/A

N/A

**Instructional Strategies:**

**Assessments:**

Coooperative groups  
Problem solving activities  
Lecture  
Group discussion  
Performance task  
Research

- Tests
- Projects

**Course Title:** Applied Discrete Mathematics

**Topic/Concept:** Scale and patterns

**Time Allotment:** 4 weeks

**Unit Sequence:** 6

**Major Concepts to be learned:**

1. Area is proportional to length squared
2. Volume is proportional to length cubed
3. All strip patterns belong to one of seven classes
4. Only certain shapes will tessellate
5. Changing scale demands a change in form

**Expected Skills to be demonstrated:**

1. Determine the new area and/or length of an object after calculating the linear scaling factor
2. Calculate the percent change in a number and express it correctly using words
3. Relate the Fibonacci sequence to the Golden Ratio
4. Classify rosette and strip patterns using crystallographic notation
5. Create a tiling that satisfies the Conway criterion by modifying a polygon capable of producing a monohedral tessellation

**PA Standards/Anchors:**

**Eligible Content:**

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**Instructional Strategies:**

**Assessments:**

Cooperative groups Problem solving activities Lecture Group discussion Performance task	<ul style="list-style-type: none"><li>• Tests</li><li>• Projects</li></ul>
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**Course Title:** Applied Discrete Mathematics

**Topic/Concept:** Personal Finance

**Time Allotment:** 3 weeks

**Unit Sequence:** 7

**Major Concepts to be learned:**

1. The time value of money

**Expected Skills to be demonstrated:**

1. Develop a financial plan, taking into account the time value of money, to meet future financial needs

**PA Standards/Anchors:**

**Eligible Content:**

N/A

N/A

**Instructional Strategies:**

**Assessments:**

Lecture  
Performance task  
Research

- Tests
- Projects