BROWARD COLLEGE
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Course Outline

Course Title: Mathematical Thinking

Common Course Title: COURSE_DEFINITION-3-13380

Effective Term: Fall 2024 (Aug 9, 2024)

Next Review : Aug 8, 2029

Credit Hours: 3 Units

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

Total: 48

Lecture: Lab:

Clinic: Other:

Requirements

This course does not have any pre-requisites or co-requisites.

Course Description:

This course will include 4 units. The 3 units, Number Sense, Real-world Geometry, and Logic in Context are required. The fourth unit on mathematical modeling is also required and may either be a unit on Linear and Exponential Models, or a unit on Modeling with Graph Theory, at the instructor's discretion. This course will also emphasize applications to real-world situations and will include projects and/or student-centered activities. The course will demonstrate the applications of mathematics in areas such as humanities, culinary sciences, business, personal finance, natural sciences, and/or sociology.

Course Outline

Alignment of General Education Competencies with General Outcomes of this Course (for general education assessment purposes)

1. Critical Thinking

1.0, 2.0, 3.0, 4.0, 5.0

2. Effective Communication

1.0, 2.0, 3.0, 4.0, 5.0

3. Ethical Reasoning

4. Global Awareness

5. Information Literacy

6. Mathematical and Scientific Reasoning

1.0, 2.0, 3.0, 4.0, 5.0

UNITS

Unit 1: Number Sense

General Outcome

1.0 Students will be able to mathematize real-life scenarios using appropriate numbers and operations with the aid of a calculator or other appropriate technology.

Specific Learning Outcomes

1.1 Identify prime numbers and explain how they are used in real-life scenarios such as the color of pixels on a screen, the reduction of harmonics in manufacturing, or the life cycles of cicadas.

1.2 Demonstrate an understanding of the concept of divisibility in the context of real-world applications.

1.3 Calculate the greatest common factor (GCF) and the least common multiple (LCM) of a list of numbers and apply them to real-life scenarios such as the orbit of planets, or timing of traffic lights. 1.4 Simplify expressions using appropriate order of operations in contextual situations such as shopping, administering medications, and business.

1.5 Perform modular arithmetic and apply it to solving real-world problems such as a 12-hour clock system or checking the parity digit of an ISBN code.

1.6 Accomplish at least one of the following learning outcomes:

- Demonstrate an understanding of the relationship between the Fibonacci sequence and the Golden Ratio and explain their applications such as humanities and/or natural sciences.
- Convert between different number bases and apply to real-world applications such as programming and processing.
- Use prime numbers and/or modular equations to solve real-world problems such as data encryption or cryptography.

Unit 2: Real-World Geometry

General Outcome

2.0 Students will apply geometric principles to solve real-world problems with the aid of a calculator or other appropriate technologies.

Specific Learning Outcomes

2.1 Identify appropriate units of English and metric measurement for a given scenario and calculate unit conversions in applications.

2.2 Find perimeter, circumference, areas, surface area and volumes of various plane, space and composite figures; then apply them to real-life applications, such as estimating costs of household projects.

2.3 Distinguish between real-world scenarios in which circumference, perimeter, area, or volume are applicable.

2.4 Predict the impact on the area or volume of an object when one or more dimensions are changed.

2.5 Use the Pythagorean Theorem to find distances in real-life applications.

2.6 Use proportions of similar triangles and concepts of scale for indirect measurement in real-life applications that may include architecture, design, culinary sciences, etc.

Unit 3: Logic in Context

General Outcome

3.0 Students will apply logic in contextual situations to formulate and determine the truth values of logical statements and the validity of logical arguments.

Specific Learning Outcomes

3.1 Describe real world scenarios in which a simple statement with quantifiers would be true and those in which it would be false.

3.2 Determine the truth values of conjunctions, disjunctions, and conditional statements based on the truth values of their components in real world scenarios.

3.3 Identify logically equivalent and non-equivalent statements with quantifiers, conjunctions and/or disjunctions by comparing their truth values in various scenarios.

3.4 Find negations of conjunctions, disjunctions, conditional statements, and statements with quantifiers.

3.5 Write the converse, inverse, and contrapositive of a conditional statement.

3.6 Define and identify tautologies and fallacies.

3.7 Identify the premises and conclusion of a real-world argument.

3.8 Analyze real-life arguments and determine their validity using Euler Diagrams and common valid and invalid reasoning/ argument forms.

Unit 4: Linear and Exponential Modeling (Either this unit or Unit 5 is required for this course.)

General Outcome

4.0 Students will be able to derive linear and exponential models from real-life scenarios.

Specific Learning Outcomes

4.1 Understand slope as a rate of change using units necessitated by real-world scenarios such as the slope of a roof, ramp, ski lift, or slide.

4.2 Understand the meaning of the *y*-intercept within contexts such as profit over time or tracking progress on paying off debt and contemplate feasibility of different values including negative *y*-intercepts.

4.3 Construct linear models for real world scenarios such as distance travelled at a constant rate, cost of a commodity per unit, or the pressure on a diver per unit of depth.

4.4 Use linear models to interpret real data, such as evaluating in context, finding break-even points, and making predictions in context.

4.5 Differentiate between linear and exponential models by visual examination of real data points. 4.6 Use appropriate technology to model linear and exponential functions derived from real data such as the correlation between the length of a person's hand versus their foot or infection statistics for a virus.

4.7 Use exponential models to interpret real data, such as evaluating in context, and making predictions in contexts such as population growth, interest rates, or radioactive decay.

4.8 Understand the limitations of using linear and exponential modeling.

Unit 5: Modeling with Graph Theory (Either this unit or Unit 4 is required for this course.)

General Outcome

5.0 Students will be able to model real-life scenarios with Graph Theory and use the models to draw conclusions.

Specific Learning Outcomes

5.1 Compare and contrast scenarios in which data can be represented by diverse types of graphs such as simple graphs, multigraphs, undirected graphs, directed graphs, connected graphs, disconnected graphs, trees, and cyclic graphs.

5.2 Determine the degrees of vertices of graphs, apply the sum of degrees theorem, and explain the significance of the degrees of vertices in graphs representing data from various scenarios such as maps, tournaments, google searches, or social networks.

5.3 Identify and distinguish between walks, trails, paths, and circuits and give examples of applications of each. (Note: Terminology for walks, trails, paths, and circuits varies.)

5.4 Identify subgraphs of a given graph and identify isomorphic graphs.

5.5 Accomplish at least 3 of the following learning outcomes:

- Identify cyclic and complete subgraphs and investigate their significance in applications such as neuroscience and/or sociology.

- Identify trees and spanning trees, and use Kruskal’s Algorithm to find minimum spanning trees in weighted graphs representing data from real world contexts such as costs of building roadways or setting up computer networks.
- Define the chromatic number of a graph, discuss the Four-Color Problem, and use graph colorings to visually represent data and solve applications such as resolving scheduling conflicts.
- Analyze a graph representing a real-world scenario to determine connectedness, identify components, bridges, and local bridges, and evaluate the stability of the networks such as computer networks, neurological networks, and social networks.
- Solve real world applications of Euler trails, Euler circuits, and Fleury’s algorithm such as minimizing backtracking on delivery routes to reduce costs.
- Compute the number of Hamilton Cycles in a complete graph and apply the nearest neighbor method and the brute force method to find the shortest or least expensive route or circuit possible in a complete graph representing data from a real-world scenario such as the Traveling Salesperson Problem.