Prefix, Number and Name of Course: MAT 103 Introduction to Mathematics
Credit Hours: 3
In Class Instructional Hours: 3 **Labs**: 0 **Field Work**: 0

Catalog Description:
Prerequisites: none
Some of the greatest achievements of mathematical thought, highlighting the beauty and creativity of these ideas. Topics include: Fibonacci numbers; the golden rectangle; estimation; comparing infinities; fractals; the Pythagorean Theorem; the five platonic solids; and selected topics from probability and statistics. Designed for liberal arts majors who do not plan on taking further math courses.

Reasons for Revision:

Many students taking MAT 103 will take only one math course in their academic careers. The primary reason for this revision is to give these students a more complete picture of the subject of mathematics—one that goes beyond symbol manipulation and introduces them to some of the greatest achievements of mathematical thought, while highlighting the beauty and creativity of these ideas. The goal is to provide students in MAT 103 with view of mathematics itself as one of the oldest liberal arts and one which provides insights not obtainable elsewhere. To this end, topics such as comparing infinities, Fibonacci numbers, golden rectangles, and fractals have been added to the course content. Motivated by the relatively recent work of mathematicians Burger and Starbird in their text, *Heart of Mathematics,* the math department has developed, with the support of Title III, an extensive set of course materials that make these traditionally more advanced topics in mathematics accessible to all students. In accordance with the recommendations of the Mathematical Association of America's (MAA) Committee on the Undergraduate Program in Mathematics (CUPM), these added course materials engage students actively in the learning process. The new course materials give students recurring opportunities to exercise and improve their critical thinking skills. By posing questions with surprising answers, students will question their intuition, and realize some situations require more rigorous examination. As the questions the students explore are not merely computations, there is an emphasis upon communicating mathematical ideas through writing.

Student Learning Outcomes Students will:	**Content References**	**Assessment**
1. demonstrate an ability to explain reasoning and logic in classical mathematical proofs.	II, III, IV	1. Group work, classroom activities, individual assignments, exams and projects.
2. analyze and explain situations involving uncertainty using	II.A, V	2. Group work, classroom activities, individual

estimation techniques and basic probability.		assignments, exams and projects.
3. critically examine counter-intuitive situations and demonstrate a refined intuition and mathematical skepticism about events that occur in our lives.	I, II.A,V	3. Group work, classroom activities, individual assignments, exams and projects.
4. discuss and analyze quantitative relationships in patterns from nature, numbers, and geometry, and use symbolic notation to express those relationships.	I–V	4. Group work, classroom activities, individual assignments, exams and projects.
5. critically examine media presentations of mathematical ideas.	V	5. Group work, classroom activities, individual assignments, exams and projects.
6. demonstrate an understanding of different sizes of infinity by showing the existence (or nonexistence) of a one-to-one correspondence between infinite sets.	III	6. Group work, classroom activities, individual assignments, exams and projects.
7. solve problems in small groups within a Socratic environment during in-class activities.	I–V	7. Group work, classroom activities.
8. demonstrate the ability to communicate mathematical ideas orally and in writing.	I–V	8. Group work, classroom activities, individual assignments, exams and projects.

Course Content:

I. Strategies for problem solving
- A. Making and testing conjectures
- B. Breaking harder problems into easier ones
- C. Looking for patterns and similarities
- D. Finding pictorial/abstract representations for given information
- E. Learning from failed attempts

II. Classical topics from number theory
- A. Natural numbers
  1. Counting and estimation
  2. Pigeonhole principle
- B. Prime numbers
  1. Definition
  2. Division algorithm
  3. Prime factorization
  4. Proof that there are infinitely many primes
- C. Fibonacci numbers
  1. Definition
  2. Symbolic notation
  3. Relationship to the golden ratio phi
  4. Examples of Fibonacci numbers in nature

III. Infinity
- A. Definition of rational and irrational numbers and characterization by decimal expansion
- B. 1-1 correspondence
- C. Cardinality
  1. Sets with cardinality equal to that of the natural numbers
  2. Sets with cardinality greater than that of the natural numbers

IV. Classical and contemporary topics from geometry
- A. Compare and contrast classical proofs of the Pythagorean theorem
- B. Golden rectangles
  1. Construction
  2. Examples in art and architecture
- C. Platonic solids
  1. Construction
  2. Duality
  3. Euler's formula
- D. Fractals
  1. Concept of an infinitely self-similar object
  2. Construction of Seirpinki's carpet and other fractals
  3. Define dimension of a fractal
- E. The fourth dimension

V. Probability and statistics for good citizenry
  A. Definition
    1. Equally likely outcomes, events
    2. Relative frequency and the law of large numbers
  B. Analyzing coincidences and using randomness and probability for decision making
  C. Collecting and describing data
    1. Random sampling & sampling bias
    2. Surveys and polling
    3. Making inferences from data
    4. Examples of misuses of statistical argument

Resources

Scholarship:

Barnsley, Michael, Fractals Everywhere (2nd Ed.), Academic Press, 1993.

Berger, Edward & Starbird, Michael, The Heart of Mathematics, Key College Publishing, 2000.

Best, J., Damned Lies and Statistics: Untangling Numbers from the Media, Politicians, and Activists, University of California Press, 2001.

Brown, Steve, Some Prime Comparisons, National Council of Teachers, 1979.

Bruter, Claud P.(ed), Mathematics and Art: Mathematics and Visualization in Art and Education, Springer Verlag, 2002.

Devlin, K., The Math Gene: How Mathematical Thinking Evolved and Why Numbers Are Like Gossip, Basic Books, 2001.

Dunlap, Richard A., The Golden Ratio and Fibonacci Numbers, World Scientific, 1997.

Emmer, Michele, The Visual Mind: Art and Mathematics, MIT Press, 1995.

Gamow, George, One, Two, Three...Infinity, Bantum, 1969.

Gigerenzer, G., Calculated Risks. How to Know When Numbers Deceive You, Simon& Shuster MacMillan Co., 2002.

Henderson, Linda Dalrymple, The Fourth Dimension and Non-Euclidean Geometry in Modern Art, Princeton University Press, 1983.

Hinton, P. R., Statistics Explained: A Guide for Social Science Students, Routledge, 1995.

Huff, D., How to Lie With Statistics, W.W. Norton & Company, 1954.

Levitt, Steven D., & Dubner, Stephen J., Freakonomics: A Rogue Economist Explores the Hidden Side of Everything, HarperCollins Publishers, 2005.

Moore, D. S., Statistics Concepts and Controversies, (3th Ed),W. H. Freeman & Co., 1991.

Niederman, D., & Boyum, D., What the Numbers Say: A Field Guide to Mastering our Numerical World, Broadway Books, 2003.

Paulos, J. A., A Mathematician Reads the Newspaper, Anchor, 1997.

Paulos, J. A., Innumeracy: Mathematical Illiteracy and Its Consequences, Hill and Wang, 2007.

Peitgen, Hanz-Otto, Jürgens, Hartmut and Saupe, Dietmar, Fractals for the Classroom, Springer Verlag, 1992.

Rosenthal, J. S., Struck by Lightning: The Curious World of Probabilities, John Henry Press, 2006.

Stewart, Ian, Flatterland, Pegasus Publishing, 2001.

Tannenbaum, Peter, Excursions in Modern Mathematics (5th Ed), Prentice Hall, 2003.

Weeks, Jeffrey R., The Shape of Space, Marcel Dekker, Inc., 1985.

Periodicals:

American Mathematics Monthly
College Mathematics Journal
Math Horizons
Mathematics Magazine

Electronic or Audiovisual Resources:

Buffalo State College MAT103 instructor resources: https://angel.buffalostate.edu/

Fibonacci numbers and the golden section:
http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/

Golden ratio: http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/phi.html

Michael Starbird, Vignettes on Teaching:
http://www.ma.utexas.edu/users/starbird/vignettes.html

The Heart of Mathematics Resource Center, Key College Publishing:
http://www.heartofmath.com/

Proofs of the Pythagorean Theorem: http://www.cut-the-knot.org/pythagoras/index.shtml

Seirpinski's Triangle flash demonstration:
http://humanitiesinstitute.utexas.edu/resources/toolkit/math/