

LAST REVIEW: 2010 – 2011
(i.e. 2006-2007)

NEXT REVIEW: 2015 – 2016
(i.e. 2011-2012)

STATUS: A
(A, I, D)

COURSE TITLE: Mathematics for Liberal Arts II

COMMON COURSE NUMBER: MGF 1107

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN

(Per 16 week term)

CLOCK HOURS:
(Voc. Course ONLY)

Lecture: **48** Lab:
Clinic: Other:

PREREQUISITE(S): MAT 1033

COREQUISITE(S): None

PRE/COREQUISITE(S): None

COURSE DESCRIPTION *(750 characters, maximum):*

This is a general education course which includes college-level skills from a variety of mathematical topics. The course will include at least four selected topics from among: mathematics of finance; linear and exponential functions; number systems; history of mathematics; elementary number theory; graph theory; numerical methods and algorithms; game theory; voting and apportionment theory; and student project(s) (strongly recommended). This course will also emphasize applications to real-world situations and the integration of other academic disciplines, including (but not limited to) business and the physical and social sciences. Meets Area 5A of the general education requirements for the A.A. degree. Meets Areas 4 or 5 of the general education requirements for the A.S. degree. Recommendation of the Mathematic Department or at least a grade of “C” in the prerequisite course is required.

General Education Requirements – Associate of Arts Degree (AA), meets Area(s): Area 5
General Education Requirements – Associate in Science Degree (AS), meets Area(s): Area 4
General Education Requirements – Associate in Applied Science Degree (AAS), meets Area(s): Area 4

UNIT TITLES

Upon successful completion of this course, the students should be able to demonstrate competence in a minimum of four of the ten units described in this course outline.

***At least one of units 1, 2, 3, and/or 5 must be selected.**

- 1. * Mathematics of Finance**
- 2. * Linear and Exponential Functions**
- 3. * Number Systems**
- 4. History of Mathematics**
- 5. * Elementary Number Theory**
- 6. Graph Theory**
- 7. Numerical Methods and Algorithms**
- 8. Game Theory**
- 9. Voting and Apportionment Theory**
- 10. Student Project(s) (strongly recommended)**

*** Complete the following only if course is seeking general education status ***

GENERAL EDUCATION Competencies and Skills *:

In the box to the right of the Competency/Skill, enter all specific **student learning outcome** unit numbers, as indicated in the course outline (i.e. 1.1, 2.7, 4.2, 4.0 and 5.12) that apply.

Course must include <u>all</u> of the following:	
1. Read with critical comprehension**	1.3, 1.4.4, 1.5, 2.8, 3.9, 3.10, 4.0, 5.5, 5.9, 5.11, 6.4, 8.8, 9.2, 9.3, 9.5, 9.6, 10.0
2. Write clearly and coherently**	1.2, 1.4, 2.4, 3.7, 4.0, 5.3, 5.4, 5.5, 5.8, 5.9, 5.11, 6.4, 8.2, 8.4, 8.8, 9.0, 10.0
3. Demonstrate literacy as appropriate within a given discipline**	(a, e): 1.0, 2.0, 3.0, 4.0, 5.0, 8.8, 8.9, 9.0, 10.0 (b): 1.2, 1.4, 2.5, 2.6, 2.7, 7.0 (d): 9.3, 9.6
4. Apply problem solving skills or methods to make informed decisions in a variety of contexts**	1.0, 2.0, 3.0, 5.0, 6.4, 8.3, 8.5, 8.7, 9.1, 9.2, 9.4, 9.5
Course must include at least <u>one</u> of the following:	
5. Differentiate between ethical and unethical behavior	
6. Demonstrate an understanding of the physical, biological, and social environments and how individual behaviors impact this complex system.	1.0, 2.0, 3.1, 3.2, 4.0, 5.11, 9.0
7. Demonstrate an understanding of and appreciation for human diversities and commonalities.	
8. Speak and listen effectively.	

**General Education Competencies and Skills endorsed by 2010-2011 General Education Task Force*

****Required Competencies**

1) Read with critical comprehension.

The student will be introduced to the basic texts, concepts, vocabulary, and methods necessary for developing an understanding of the discipline and meeting the required benchmarks as stated in the course outline.

2) Write clearly and coherently.

The student will demonstrate an understanding and mastery of subject matter in a variety of ways, including writing. Writing activities may include both graded and ungraded essays, short answer quizzes, summaries, reactions, journals, and various other reports.

3) Demonstrate and apply literacy across all the disciplines (indicate which ones apply).

- a) **Information literacy** means understanding how to locate needed information, using the appropriate technology for the task, managing and evaluating the extracted information and using it effectively and ethically.
- b) **Technology literacy** is the ability to responsibly and effectively use appropriate technology to access, manage, integrate, or create information, and/or use technology to accomplish a given task.
- c) **Workplace literacy** is having the appropriate knowledge and skills to communicate and work with others effectively and perform job duties, whether it is through the use of computers and/or other technology.
- d) **Cultural literacy** is recognizing, understanding, and appreciating the similarities and differences between one's own culture and the cultures of others through a study of the arts, customs, beliefs, values, and history that define a culture.
- e) **Quantitative literacy** is having the ability to formulate, solve and interpret mathematical/statistical operations and graphical/tabular representations to make informed decisions.
- f) **Scientific literacy** means understanding the methodology and application of the scientific process, the physical and biological worlds, and recognizing that scientific knowledge is continuously updated or revised as new information is discovered.

- 4. Apply problem-solving skills or methods to make informed decisions in a variety of contexts.**
The student will use acquired skills or methods to recognize, analyze, adapt, and apply critical thinking to solve problems and make informed decisions.

EVALUATION:

In the box to the right of the Methods of Assessment, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 4.0, 4.2 and 5.12) that apply.

1. Portfolio	
2. Short essays	1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
3. Research Papers	10.0
4. Group projects	10.0
5. Discussions (In class and online)	
6. Multiple Choice tests	1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
7. Presentations	10.0
8. Service Learning Projects	
9. Quizzes (pop, announced, etc.)	1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
10. Take-home tests	1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
11. Summaries, critiques, and analyses	
12. Reaction papers	
13. Surveys	
14. Performance	
15. Short answer tests	1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0
16. Classroom debates and colloquia	
17. Blogs, wikis, web pages	
18. Other (Please explain)	

Common Course Number: MGF 1107

Unit 1 Mathematics of Finance

General Outcome:

- 1.0 The student shall be able to apply mathematics to solve problems in the area of finance.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 1.1 Demonstrate an understanding of the utilization of mathematics in simple and compound interest applications.
- 1.2 Solve a variety of money application problems (with the use of appropriate technology and with the solution expressed in terms of the problem's context), including (but not restricted to):
 - 1.2.1 Simple interest
 - 1.2.2 Future and present values
 - 1.2.3 Unearned interest and payoff amounts
- 1.3 Demonstrate knowledge of consumer loan application problems, including (but not restricted to):
 - 1.3.1 Credit loans and payments
 - 1.3.2 Credit cards and finance charges
- 1.4 Demonstrate an understanding of fixed rate mortgages, including (but not restricted to):
 - 1.4.1 Calculate regular monthly payment with the use of appropriate technology
 - 1.4.2 Escrow accounts
 - 1.4.3 Closing costs and other expenses associated with buying a house
 - 1.4.4 Reading amortization schedules
 - 1.4.5 Mortgage interest and tax implications
- 1.5 Demonstrate a basic understanding of investing and personal finance, including (but not restricted to):
 - 1.5.1 Basic types of investments and their associated risks
 - 1.5.2 Basic investing terminology
 - 1.5.3 Traditional IRAs and Roth IRAs
 - 1.5.4 Finances associated with buying a vehicle

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Unit 2 Linear and Exponential Functions

General Outcome:

- 2.0 The student shall be able to evaluate and interpret linear, quadratic, and exponential functions as mathematical models.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 2.1+ Calculate the slope and intercepts of linear equations.
- 2.2+ Graph linear equations.
- 2.3 Demonstrate basic knowledge of functions, including recognizing linear functions, using appropriate function notation, and evaluating functions.
- 2.4 Write, evaluate, and interpret linear functions.
- 2.5 Evaluate and interpret quadratic functions with the appropriate use of technology.
- 2.6 Evaluate and interpret exponential functions with the appropriate use of technology.
- 2.7 Evaluate and interpret logarithmic functions with the appropriate use of technology.
- 2.8 Read, evaluate, and interpret functions used to solve applied problems, including (but not restricted to):
- 2.8.1 Average rate of change
 - 2.8.2 Cost, revenue, and profit functions
 - 2.8.3 Maxima and minima
 - 2.8.4 Population growth models
 - 2.8.5 Growth and decay models

+ Review as needed

Common Course Number: MGF 1107

Unit 3 Number Systems

General Outcome:

- 3.0 The student shall be able to demonstrate knowledge of various number systems and perform operations within the different systems.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 3.1 Demonstrate knowledge of the history of number systems.
- 3.2 Demonstrate knowledge of the Hindu Arabic number system and its impact on modern mathematics.
- 3.3 Perform conversions between different number base systems.
- 3.4 Perform addition, subtraction, and multiplication operations in different number base systems.
- 3.5 Perform addition, subtraction, and multiplication in modular systems, including the 12-hour clock system.
- 3.6 Determine whether a system satisfies the closure, commutative, associative, identity, and inverse properties.
- 3.7 Determine if a system satisfies the properties of a group and explain why or why not.
- 3.8+ Demonstrate knowledge of the set of real and non-real complex numbers, including (but not restricted to):
- 3.8.1+ Counting numbers, whole numbers, integers, rational number, and irrational numbers
 - 3.8.2+ Order of operations
 - 3.8.3+ Properties associated with real and non-real complex numbers
- 3.9+ Read, evaluate, and find errors in elementary mathematical problems.
- 3.10+ Read and solve applied problems, including (but not restricted to):
- 3.10.1+ Problems involving integers
 - 3.10.2+ Problems involving fractions
 - 3.10.3+ Problems involving percentages

+ Purely optional learning outcomes, up to the discretion of the instructor (e.g., perhaps worthwhile as a supplementary inclusion for elementary-education majors)

Common Course Number: MGF 1107

Unit 4 History of Mathematics

General Outcome:

- 4.0 The student, through research, reading, and writing, shall be able to demonstrate an understanding of the history of mathematics and be able to identify important events and contributions made by various mathematicians and cultures.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 4.1 Demonstrate an understanding of the contributions to Mathematics made by the Egyptian culture and Babylonian culture during the period of 3000 B.C. - 600 B.C.
- 4.2 Demonstrate an understanding of the contributions to Mathematics made by the Greek culture during the period of 600 B.C. - A.D. 500.
- 4.3 Demonstrate an understanding of the contributions to Mathematics made by the Hindu culture and Arab culture (during the dark ages of Mathematics) during A.D. 500 - A.D. 1200.
- 4.4 Demonstrate an understanding of the contributions to Mathematics during the Period of Transition, A.D. 1200 - A.D. 1550.
- 4.5 Demonstrate an understanding of the contributions to Mathematics during the Modern Period, A.D. 1550 - present.

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Unit 5 Elementary Number Theory

General Outcome:

- 5.0 The student shall be able to demonstrate an understanding of number theory concepts/techniques and apply them to solve problems.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 5.1 Demonstrate an understanding of the concept of divisibility.
- 5.2 Calculate the greatest common factor (GCF) and the least common multiple (LCM) of a list of numbers.
- 5.3 Calculate the GCF using the division algorithm.
- 5.4 Use the division algorithm to write the GCF of (a,b) as a linear combination of a and b.
- 5.5 Apply the division algorithm to problem solving.
- 5.6 Demonstrate an understanding of the Unique Factorization Theorem; and write numbers as a product of prime factors.
- 5.7 Demonstrate an understanding of the properties of prime divisors (e.g., $p|(ab) \Rightarrow p|a$ or $p|b$).
- 5.8 Demonstrate an understanding of congruencies modulo m , including performing operations in modular systems (e.g., the 12-hour clock system) and solving linear congruencies.
- 5.9 Read applied problems and use modular equations to solve them.
- 5.10 Determine if a number is perfect, deficient or abundant.
- 5.11 Demonstrate an understanding of the concept of modern cryptography by applying the concepts of this unit to encode and decode messages.
- 5.12 Demonstrate an understanding of the Fibonacci sequence and its relationship to the Golden Ratio.

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Unit 6 Graph Theory

General Outcome:

- 6.0 The student shall be able to recognize different kinds of graphs, circuits, and trees, and relationships among them.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 6.1 Demonstrate an understanding of graphs, subgraphs, paths and connections, cycles, and isomorphisms between graphs.
- 6.2 Determine if a graph is a tree.
- 6.3 Demonstrate an understanding of Hamilton cycles and Euler tours.
- 6.4 Read classic problems in graph theory and apply the ideas of this unit to solve them.

Common Course Number: MGF 1107

Unit 7 Numerical Methods and Algorithms

General Outcome:

- 7.0 The student shall, with the aid of a programmable calculator or computer software, approximate parameters for numerical or measured data using simple algorithms.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 7.1 Recognize irrational and rational numbers; and distinguish the properties of their decimal representations.
- 7.2 Determine the appropriate number of significant digits in a measured number and in the result of a calculator.
- 7.3 Estimate the error in a calculation.
- 7.4 Estimate the rate of change in a measured quantity over an interval; and estimate the total change in the value of this quantity.
- 7.5 Apply simple numerical algorithms, including recursive and successive approximation techniques, to estimate the value of a parameter. Two examples of methods to be used are Monte Carlo and binary-chopping.
- 7.6 Write a program for a calculator or a spreadsheet for a numerical algorithm.

Unit 8 Game Theory

General Outcome:

- 8.0 The student shall be able to demonstrate knowledge of the process for decision-making based on an understanding of game theory and its analytical techniques.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 8.1 Demonstrate the development of alternatives and decisions for a specific problem.
- 8.2 Create a model which addresses a description of consequences, a determination of attributes, and a development of the measures of performance.
- 8.3 Relate alternatives to consequences for any decision-making scenario.
- 8.4 Develop a tree diagram portraying all decisions and alternatives in sequential order.
- 8.5 Assign probabilities (simple, joint, and conditional) to all outcomes resulting from any decisions.
- 8.6 Determine the contribution for any terminal branch of the tree based on a sequence of decisions and alternatives.
- 8.7 Decide the optimal alternative(s) based on pay-off computations.
- 8.8 Conduct research to provide examples of "real world" instances in which game theory has been (or is currently being) used to achieve a decision.
- 8.9 Participate in projects from other disciplines which involve the need to analytically arrive at decisions and recommendations.

Unit 9 Voting and Apportionment Theory

General Outcome:

- 9.0 The student shall be able to apply the methodology of social choice theory to election scenarios and apportionment problems and assess the attributes and deficiencies of each method.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 9.1 Apply various methods to determine the outcome of an election, including (but not restricted to) the following five methods: majority, plurality, pairwise comparison, Borda, and Hare.
- 9.2 Rate each voting method in terms of how many of the four desirability principles it satisfies; namely, the majority criterion, the Condorcet criterion, the monotonicity criterion, and the irrelevant alternatives criterion.
- 9.3 Read Arrow's Impossibility Theorem and interpret its societal implications on democratic decision-making processes.
- 9.4 Apply various historical and current methods to apportionment problems, including (but not restricted to) the following five methods: Hamilton, Jefferson, Webster, Adams, and Huntington-Hill.
- 9.5 Evaluate each apportionment method in terms of the following four fairness standards: the Quota Rule, the Alabama Paradox, the Population Paradox, and the New States Paradox.
- 9.6 Read Balinski and Young's Impossibility Theorem and interpret its societal implications on democratic decision-making processes.

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Unit 10 Student Project(s)

General Outcome:

- 10.0 The student shall be able to research a topic in mathematics, critically analyze the research, and present the results in a well composed and well organized fashion. The instructor will assign the project(s) and specify the format for the report.

Specific Measurable Learning Outcomes:

Specific measurable learning outcomes appropriate to the project assignment will be established by the instructor.