# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*084a

Course Title: Fundamentals of Mathematics I, Lecture Only (NDU) Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

This course is a lecture-based and is equivalent to MA*085. This course is a study of the fundamental concepts of high school mathematics, including arithmetic, algebra, and informal geometry. The course is designed to provide the background necessary for advancement in mathematics. Placement into this course is determined by Mathematics Placement Test. Grades of P (Pass), or NC (No Credit), or F (Failure).

**2. Course Content:**

The course content consists of textbook chapters as follows:

The MA*084a covers Chapters 1 to 10, Appendix B (Section 1 through Section 4)

**3. Rationale for the Course:**

The majority of entering freshmen lack the skills and concepts of standard high school math; thus, they are not prepared for college-level math courses. This course provides the background needed for college math.

**4. Skills and Background Required or Expected:**

Basically, just a knowledge of numbers is expected. The content of MA*084a is what is required and should be expected of high school graduates.

**5. Teaching Methodologies and Anticipated class size:**

MA*084a is a lecture-based course. Every chapter content is scheduled to be lectured, discussed, and tested within two weeks. There will be lecture and discussion in the class in the first week and test in the second week. Students will be given a chance for one make-up exam for each chapter. Class size is 20.

**6. Learning Objectives for Students:**

- Perform algebraic operations on integers, fractions, decimals and expression involving variables.
- Construct equations representing word problems and solve the equations mathematically.
- Compute percentages in order to interpret statistical data.
- Convert the units between two different systems.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Every chapter content is scheduled to be lectured, discussed, and tested within two weeks. There will be lecture and discussion in the class in the first week and test in the second week. Students will be given a chance or one make-up exam for each chapter.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Developmental Mathematics, 4th edition by Johnston, Willis, Hughes.

**10. Subsequent Courses:**

MA*084b – Fundamentals of Mathematics II, Lecture Only (NDU)

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*084b

Course Title: Fundamentals of Mathematics II, Lecture Only (NDU) Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

This course is a lecture-based and is equivalent to MA*085. This course is a study of the fundamental concepts of high school mathematics, including arithmetic, algebra, and informal geometry. The course is designed to provide the background necessary for advancement in mathematics. Placement into this course is determined by Mathematics Placement Test. Grades of P (Pass), or NC (No Credit), or F (Failure).

**2. Course Content:**

The course content consists of textbook chapters as follows:

The MA*084b covers Chapters 11 to 17

**3. Rationale for the Course:**

The majority of entering freshmen lack the skills and concepts of standard high school math; thus, they are not prepared for college-level math courses. This course provides the background needed for college math.

**4. Skills and Background Required or Expected:**

Basically, just a knowledge of numbers is expected. The content of MA*084b is what is required and should be expected of high school graduates.

**5. Teaching Methodologies and Anticipated class size:**

MA*084b is a lecture-based course. Every chapter content is scheduled to be lectured, discussed, and tested within two weeks. There will be lecture and discussion in the class in the first week and test in the second week. Students will be given a chance for one make-up exam for each chapter. Class size is 20.

**6. Learning Objectives for Students:**

- Perform algebraic operations on integers, fractions, decimals and expression involving variables.
- Generate graphs of linear equations and inequalities.
- Interpret graphs representing statistical data.
- Use algebraic representations to solve real-life applications and problems.
- Demonstrate familiarity with geometric concepts and different units of measurement.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Class size is 20. Every chapter is scheduled to be lectured, discussed, and tested within two weeks. There will be lecture and discussion in the class in the first week and test in the second week. Students will be given a chance or one make-up exam for each chapter.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Developmental Mathematics, 4th edition by Johnston, Willis, Hughes.

**10. Subsequent Courses:**

MA*088 – Intermediate Algebra
MA*110 – Finite Mathematics
MA*151 – Introductory Statistics

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*085

Course Title: Fundamentals of Mathematics I, II (NDU) Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

This course is a study of the fundamental concepts of high school mathematics, including arithmetic, algebra, and informal geometry. The course is designed to provide the background necessary for a advancement in mathematics. Placement into this course is determined by the Mathematics Placement Test. Grades of P (Pass), or NC (No Credit), or F (Failure).

**2. Course Content:**

Operations with whole numbers, integers, and rational numbers. Very basic statistics. Basic algebra, including operations with algebraic expressions, factoring, raising to powers and taking roots, simplification, word problems, linear and quadratic equations, systems of equations and informal geometry.

**3. Rationale for the Course:**

A majority of entering freshmen lack the skills and concepts of standard high school math; thus, they are not prepared for college-level math courses. This course provides the background needed for college math.

**4. Skills and Background Required or Expected:**

Basically, just a knowledge of numbers is expected. The content of MA*085 is what is required and should be expected of high school graduates.

**5. Teaching Methodologies and Anticipated class size:**

Self-paced. Individual tutoring. Classes are 35 students depending on the classroom.

**6. Learning Objectives for Students:**

- Perform algebraic operations on integers, fraction, decimals and expression involving variables.
- Sketch graphs of liner equations and interpret graphs representing statistical data.
- Construct equations representing word problems and solve the equations mathematically.
- Demonstrate familiarity with geometric figures and the different units of measurement.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Chapter tests. Minimum grade of 80% required for passing tests. When all tests are passed student completes course.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Developmental Mathematics, 4th edition by Johnston, Willis, Hughes.

**10. Subsequent Courses:**

MA*088 – Intermediate Algebra
MA*110 – Finite Mathematics
MA*151 – Introductory Statistics

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*088

Course Title: Intermediate Algebra Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

**1. Catalog Description:**

This course prepares students for college level mathematics courses. Topics include polynomial equations; radical expressions; systems of equations and inequalities; functions; inverse functions; graphing; rational, exponential, and logarithmic functions; and application problems. This course counts as part of the student's load, but does not satisfy any GE requirement and does not count towards the units required for graduation. Prerequisite: MA*085, Level II, completed within the previous 3 semesters, or placement into MA*088.

**2. Course Content:**

Polynomial equations; radical expressions; systems of equations and inequalities; functions; inverse functions; graphing; rational, exponential, and logarithmic functions; and application problems.

**3. Rationale for the Course:**

The purpose of an Intermediate Algebra course is to prepare students for success in MA*161a, and MA*165. The student is asked to solve problems similar to those encountered in Elementary Algebra, but at a more sophisticated, more difficult level. This helps the student to absorb and understand the underlying concepts better and to feel more comfortable with the material. It also improves retention of basic algebraic techniques and ideas. Intermediate Algebra is the course in which students are introduced to inverse functions, exponential functions, and logarithmic functions. A basic understanding of these concepts is critical for success in any college level mathematics course, as well as in physics, chemistry, economics, biology, and many other subjects.

**4. Skills and Background Required or Expected:**

The student should have a solid command of the material in MA*085 before entering MA*088.

**5. Teaching Methodologies and Anticipated class size:**

This course may be offered as a lecture course or a self-paced workshop. A combination of approaches may also be used. Anticipated class size is 15-25 students.

**6. Learning Objectives for Students:**

- Demonstrate enhancement of basic fluency, in routine operations of elementary algebra (short pre-and post-session test will be administered)
- Graph and sketch linear, quadratic, polynomial, rational, exponential and logarithmic functions.
- Show facility with the analytic treatment of linear, quadratic, polynomial, rational, radical , exponential and logarithmic functions.
- Exhibit evidence of a thorough acquaintance with exponential and logarithmic functions and with applications of these functions in such fields as the mathematics of personal finance, biology and physical science.

- Formulate equations from quantitative data, given verbally; use learned algebraic methods to solve simultaneous sets of linear equations, to include the introductory use of elementary matrix methods.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Students are evaluated by exams, graded homework, and quizzes, as deemed appropriate by the instructor. The students in each MA*088 class are given a Division final exam. A student must pass the Division Final to earn a passing (C or better) grade in MA*088.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Intermediate Algebra, 4th edition, by Tussy and Gustafson.

**10. Subsequent Courses:**

MA*161a – College Algebra and Trigonometry
MA*165 – PreCalculus

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*110

Course Title: Finite Mathematics Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: x general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

This covers linear, quadratic, polynomial, exponential and logarithmic functions, and their applications to finance and economics. The course also provides an introduction to solving systems of linear equations, matrix operations, and a treatment of linear programming which includes the simplex method.
Prerequisite: MA*084b, MA*085 Level II or placement.

**2. Course Content:**

Basic algebraic operations; equations, graphs, and functions; exponential and logarithmic functions; mathematics of finance; systems of linear equations; Gauss-Jordan elimination; matrix operations; linear inequalities; and introduction to linear programming.

**3. Rationale for the Course:**

Finite Mathematics satisfies general education requirement. It introduces the finite, discrete side of mathematics.

**4. Skills and Background Required or Expected:**

MA*085 Level II or appropriate placement test score.

**5. Teaching Methodologies and Anticipated class size:**

This course is lecture-oriented with emphasis on solving problems in finite mathematics. Attendance is necessary and the student must be present for all examinations. Assigned reading and homework problems must be completed prior to all class meetings. Students are required to perform extensive homework assignments. Calculators with exponential, logarithmic, power and square root function keys are required for solving some of the problems. Class size should be limited to 25.

**6. Learning Objectives for Students:**

- Demonstrate familiarity with linear, quadratic, exponential and logarithmic functions.
- Apply the concept of function in making models for problem solving.
- Solve systems of equations and perform operations on matrices.
- Construct mathematical models and solutions for optimization problems graphically.

**Note:** With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, and class participation, all aimed at determining extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Finite Mathematics for Business, Economics, Life and Social Sciences, 11th edition, authored by Barnett, Ziegler and Byleen. Published by Pearson Education.

**10. Subsequent Courses:**

MA*110 is a terminal course.

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*151

Course Title: Introductory Statistics Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

This course presents statistical methods as applied to the description and display of data, and to drawing conclusions from statistical data, and introduces the basic probability theory needed to understand and use the techniques of elementary statistics. Prerequisite: MA*084b, MA*085 Level II or placement.

**2. Course Content:**

Methods for describing sets of data, including graphical and numerical methods such as means, modes, and standard deviation; probability theory; probability distributions and expected values; the binomial random variable; the normal distribution; sampling distributions and the Central Limit Theorem, as time permits estimation and tests of hypotheses for population means and binomial proportions for both large and small samples.

**3. Rationale for the Course:**

Statistics pervades modern society. An ability to analyze and evaluate data, statistical summaries, and inferences is essential not only for many university majors but also for any educated person.

**4. Skills and Background Required or Expected:**

Students should be able to handle detailed arithmetic calculations and elementary algebra as evidenced by completion of MA085 or an adequate score on the Mathematics Placement Test.

**5. Teaching Methodologies and Anticipated class size:**

The course will involve lectures, solution of exercises and problems, and discussion in a mix depending on the instructor. Class size should be limited to 25.

**6. Learning Objectives for Students:**

- Organize data and explore the frequency distribution of data.
- Represent data in frequency distributions graphically.
- Determine the probabilities of independent and dependent events.
- Use and apply the normal distribution to compute the probability of a random outcome.
- Demonstrate understanding and using linear regression to make prediction and interpretation.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, an class participation, all aimed at determining the extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

The required text is currently "Elementary Statistics: A Step by Step Approach with CD-ROM, 5th Edition, by Allan Bluman, Mc-Graw-Hill Publishing.

**10. Subsequent Courses:**

MA*151 prepares students for more advanced statistics courses, in particular MA*385, ***Applied Statistics.***

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*161a

Course Title: College Algebra and Trigonometry Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: F/SP

Course counts as: x general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

MA*161a includes algebraic, exponential and logarithmic functions, systems of equations and inequalities. MA*161b includes trigonometry, additional algebraic functions, sequences, series and probability. A student may receive credit for either the MA*161a-b sequence or MA*165 course, but not a combination of the two. Prerequisite: Grade of C or better in MA*088, or placement.

**2. Course Content:**

Equations and inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of equations and matrices. Use of graphing calculator.

**3. Rationale for the Course:**

The course satisfies General Education requirements and prepares students for MA*161b and then calculus.

**4. Skills and Background Required or Expected:**

MA*088 or Placement.

**5. Teaching Methodologies and Anticipated class size:**

Lecture - Recitation. Class size of 25 anticipated. Homework assigned regularly. 10 – 15 minute quizzes may be given throughout the semester. 2 - 3 exams are also given plus a comprehensive exam. Students are expected to attend class regularly.

**6. Learning Objectives for Students:**

- Demonstrate an understanding of polynomial, rational, exponential, and logarithmic functions and their corresponding graphical representations.
- Generate graphs of polynomial, rational, exponential, and logarithmic functions without graphing calculator.
- Use polynomial, rational, exponential, and logarithmic functions to solve real-life application and problems.
- Demonstrate an understanding and application of systems of equations.
- Use and apply the matrix method to solve systems of equations.
- Sketch the graphs of different kinds of functions, identify their domain and range, and construct new functions from a given set of functions.
- Solve different kinds of equations: linear, quadratic, radical, polynomial, exponential and logarithmic.
- Formulate appropriate mathematical equations and use these equations to solve world problems.
- Demonstrate skill in performing the fundamental operations on radicals, polynomials and complex numbers.

- Perform algebraic operations on matrices and apply this knowledge in solving system of linear equations.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Instructor dependent.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Contemporary Precalculus, a Graphing Approach, $4^{th}$ edition by T. Hungerford, Harcourt Brace College.

**10. Subsequent Courses:**

MA*161b.

**11. Additional Course Descriptors, if any:**

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*161b

Course Title: College Algebra and Trigonometry Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: F/SP

Course counts as: x general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

MA*161a includes algebraic, exponential and logarithmic functions, systems of equations and inequalities. MA*161b includes trigonometry, additional algebraic functions, sequences, series and probability. A student may receive credit for either the MA*161a-b sequence or MA*165 course, but not a combination of the two. Prerequisite: Grade of C or better in MA*088, or placement.

**2. Course Content:**

Equations and inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of equations and matrices. Use of graphing calculator.

**3. Rationale for the Course:**

The course satisfies General Education requirements and prepares students for calculus.

**4. Skills and Background Required or Expected:**

MA*161a or Placement.

**5. Teaching Methodologies and Anticipated class size:**

Lecture - Recitation. Class size of 25 anticipated. Homework assigned regularly. 10 – 15 minute quizzes may be given throughout the semester. 2 - 3 exams are also given plus a comprehensive exam. Students are expected to attend class regularly.

**7. Learning Objectives for Students:**

- Demonstrate understanding of trigonometric functions and the ability to sketch their graphs without a graphing calculator.
- Verify trigonometric identities and solve trigonometric equations.
- Use the Law of Cosines and the Law of Sines to solve application problems
- Demonstrate understanding of DeMoivre's Theorem, vectors, the dot product and polar coordinates.
- Demonstrate understanding of sequences, arithmetic series, geometric series, and the binomial theorem.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Instructor dependent.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Contemporary Precalculus, a Graphing Approach, 4th edition by T. Hungerford, Harcourt Brace College.

**10. Subsequent Courses:**

MA*203.

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*165

Course Title: PreCalculus Credit Hours: 5 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: x general education requirement
_____ part of _____ major program
_____ elective

**1. Catalog Description:**

Topics include algebraic, exponential and logarithmic functions; systems of equations and inequalities; trigonometry; sequences and series. A student may receive credit for either MA*161a-b sequence or the MA*165 course, but not a combination of the two. Prerequisite: Grade of C or better in MA*088 or Placement.

**2. Course Content:**

Complex numbers, functions and graphs, polynomial functions and rational functions, exponential and logarithmic functions, the trigonometric functions, analytic trigonometry, applications of trigonometry, systems of equations and inequalities, sequences and series, topics from analytic geometry.

**3. Rationale for the Course:**

The Division of Mathematical Sciences believes that completion of MA*088 will enable students to finish preparation for calculus in just one semester, which is exactly what MA*165 accomplishes. Decently prepared students should complete MA*088 and then MA*165 in their freshman year, then begin calculus in the first semester of their sophomore year. Poorly prepared students must begin in MA085, but once brought up to speed, should again be able to enter calculus after MA*088 and MA*165.

Five credit hours is needed to provide enough time for doing extended problem lists, examples, and applications. It also provides a transition to the more intense five-hour calculus courses to follow.

**4. Skills and Background Required or Expected:**

Students should be quite familiar with functions and their properties, graphs, algebra, and some geometry. They should have been exposed to exponential and logarithmic functions, as well as to applications of all the above. MA*088 does precisely this.

**5. Teaching Methodologies and Anticipated class size:**

The course will involve lectures, solution of exercises and problems, and discussion in a mix depending on the instructor. Students will regularly turn in written assignments. Class size should be limited to 25.

**6. Learning Objectives for Students:**

- Identify functional relationships between two variables, both graphically and algebraically.
- Specify the graphical and algebraic characteristics of polynomial, rational, exponential, logarithmic, and trigonometric functions.
- Employ mathematical modeling techniques to solve problems using polynomial, rational, exponential, logarithmic, and trigonometric functions..
- Identify the characteristics of the conic sections, both graphically and algebraically.

ESP Specific Goals
Students will:

⇨Develop enthusiasm for mathematics and sciences
⇨Create long lasting friendships, and learning community
⇨Become confident and independent problem solver
⇨Develop communications and team working skills

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, and class participation, all aimed at determining the extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

The required text is Contemporary Precalculus, A Graphing Approach, 4$^{th}$ edition by T. Hungerford, Harcourt Brace College.

**10. Subsequent Courses:**

MA*165 prepares students for the first calculus course, MA*203, as well as for scientific and engineering courses that use exponential, logarithmic, and trigonometric functions.

**11. Additional Course Descriptors, if any:**

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*203

Course Title: Calculus I Credit Hours: 5 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: x general education requirement
x part of Math major program
elective

**1. Catalog Description:**

This is the first semester of a standard calculus course. Topics include limits, continuity; the definition of derivatives; derivatives of algebraic and transcendental functions; product, quotient, and chain rules; applications; and Reimann Sums. Prerequisite: Grade of C or better in MA*161b or MA*165 or placement or equivalent.

**2. Course Content:**

See attached course topics.

**3. Rationale for the Course:**

This course introduces students to the fundamental ideas of calculus: limits, derivatives and the definite integral. Though not highly stressed, the mathematical foundations of these ideas are provided, so that students receive an introduction to mathematical precision and rigor. Calculus is then used to investigate ideas from physics, such as velocity, acceleration, centers of mass, from geometry, such as areas and volumes, from finance, such as capital formation, and other disciplines. Students thus receive an introduction to mathematical modeling and applied mathematics, that is, how mathematics is used to study the physical world.

**4. Skills and Background Required or Expected:**

Students should know algebra, some geometry, and some trigonometry. They should have been exposed to mathematical modeling, that is word problems. Courses in college algebra and trigonometry or precalculus suffice, which usually means MA*161a and MA*161b, or MA*165.

**5. Teaching Methodologies and Anticipated class size:**

Class time will be taken up mostly by dialogue or discussion led by the instructor, who may even lecture a bit. There may be examples in the textbook that will not be covered in class but may be needed, so students should learn to read the textbook. Class participation is important; good questions and good answers will contribute to good evaluations. Study groups and study partners may also be created. Because of the dialogue/discussion classroom methods, optimal class size should be 20 students or less.

**6. Learning Objectives for Students:**

- Demonstrate understanding of limits, continuity, and derivatives of functions.
- Use the product, quotient and chain rules for direct and implicit differentiation.
- Find derivatives of polynomial, rational, exponential, logarithmic, trigonometric and hyperbolic functions.
- Use differential calculus in curve sketching and problems solving.
- Find definite and indefinite integrals of a limited number of elementary functions.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, perhaps writing assignments, perhaps projects, and class participation, all aimed at determining the extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Single Variable Calculus: Early Transcendentals, $6^{th}$ edition by James Stewart
Single Variable Calculus: Early Transcendentals Student Solutions Manual, $6^{th}$ Edition by James Stewart.

**10. Subsequent Courses:**

A grade of C or better in MA*203 is a prerequisite for MA*204, Calculus II. MA*203 is also necessary for any calculus- based physics course.

**11. Additional Course Descriptors, if any:**

N/A.

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*204

Course Title: Calculus II Credit Hours: 5 crs.

Date of Final Approval: Semester Offered: F/SP

Course counts as: ____ general education requirement
x part of Math major program
____ elective

**1. Catalog Description:**

This is the second semester of a standard calculus course. Topics include techniques and applications of integration, differential equations, power series, and Taylor series. Prerequisite: Grade of C or better in MA*203.

**2. Course Content:**

The course covers: transcendental functions, techniques and applications of integration, indeterminate forms, improper integrals, Taylor's formula, infinite series, Fourier series, topics from analytic geometry, plane curves and polar coordinates.

**3. Rationale for the Course:**

The basic content of the course is needed by any student who is planning to continue in mathematics. The ideas introduced in this course provide a foundation for all upper division mathematics courses.

**4. Skills and Background Required or Expected:**

MA*203 (Calculus I).

**5. Teaching Methodologies and Anticipated class size:**

The anticipated class size is 20 students. The teaching method will be primarily lecture and discussion where students will regularly turn in assignments. On occasion, students will make presentations of some of the class assignments to the other students in class.

**6. Learning Objectives for Students:**

- **Apply** integrals to compute areas, volume and arc length.
- **Identify** and **perform** various techniques to evaluate integrals.
- **Solve** simple differential equations.
- **Describe** objects in both rectangular and polar coordinate systems.
- **Construct** Taylor series for different classes of functions.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, perhaps written assignments, perhaps projects, and class participation, all aimed at determining the extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Variable Calculus: Early Transcendentals, 6th edition by James Stewart
Single Variable Calculus: Early Transcendentals Student Solutions Manual, 6th Edition by James Stewart.

**10. Subsequent Courses:**

MA*205, MA*341, MA*351, and MA*375.

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*205

Course Title: Multivariable Calculus Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F

Course counts as: ____ general education requirement
x part of Math major program
____ elective

**1. Catalog Description:**

This course covers the calculus of functions of several variables including partial differentiation and multiple integration. Prerequisite: Grade of C or better in MA*204.

**2. Course Content:**

The course covers: vectors, vector-valued functions; differential calculus of functions of several variables; multiple integration; vector integral calculus which includes line integrals, line integrals independent of path, surface integrals, divergence and curls, integral theorems, etc.

**3. Rationale for the Course:**

The basic content of the course is needed by any student who is planning to continue in mathematics. The ideas introduced in this course provide a foundation for all upper division mathematics courses.

**4. Skills and Background Required or Expected:**

MA*203 and M*A204 (Basic and intermediate calculus).

**5. Teaching Methodologies and Anticipated class size:**

The anticipated class size is 20 students. The teaching method will be primarily lecture and discussion where students will regularly turn in assignments. On occasion students will make presentations of some of the class assignments to the other students in class.

**6. Learning Objectives for Students:**

- Demonstrate knowledge of the theory and applications of functions of several variables and vector-valued functions.
- Apply differential calculus, multiple integrals and vector integral calculus to solve optimization, extreme value and other application problems
- Perform partial differentiation, compute total and directional derivatives.
- Use line integrals and surface integrals to gain insight of vector fields.
- Describe divergence and curl in the context of general integral theorems.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

The details of evaluation will depend on the instructor, but it is anticipated that there will be at least three examinations, a final exam, homework, perhaps quizzes, perhaps written assignments, and class participation, all aimed at determining the extent of a student's ability to meet the learning objectives.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Multivariable Calculus, 6th edition by James Stewart, ITP.

**10. Subsequent Courses:**

Most of our upper division mathematics courses directly or indirectly require MA*205. It is highly recommended that all three semesters of our calculus sequence be completed before any attempt is made in taking upper division mathematics courses.

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*301

Course Title: Differential Equations Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP/Even Years

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

**1. Catalog Description:**

This course covers the study of the fundamental concepts of differential equations with applications. Prerequisite: Grade of C or better in MA*204.

**2. Course Content:**

First order differential equations and methods for their solution. Applications of first order equations. Solution of homogeneous linear equations of higher order, mechanical vibrations, nonhomogeneous equations, methods for finding particular solutions, forced oscillations and resonance. Power series solutions, including Bessel functions. The Laplace transform. Linear systems of differential equations. Qualitative properties and existence of solutions.

**3. Rationale for the Course:**

The basic content of the course is fundamental for any student wanting to learn about classical applications of mathematics in physics and engineering. Physical phenomena are almost without exception modeled by differential equations. Also, the course introduces students to ideas which permeate higher mathematics, such as linear independence, existence of solutions, etc.

**4. Skills and Background Required or Expected:**

Students will need the techniques and ideas of calculus covered in the first two calculus courses, MA*203 and MA*204.

**5. Teaching Methodologies and Anticipated class size:**

The anticipated class size is between ten and fifteen. Class time will be taken up by lectures, dialogue, discussion of problems and exercises, and presentation of examples in a mix determined by the instructor. There may be some small group work, particularly doing examples once guiding principles have been provided. Class participation is important.

**6. Learning Objectives for Students:**

- Demonstrate ability to use the technology surrounding the study of differential equations.
- Solve first order differential equations and those of higher order.
- Use power series, Laplace transforms, and linear algebra techniques to solve differential equations.
- Increase their mathematical maturity and ability to read mathematics and use it to solve applied problems.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Attendance and participation are an integral part of this course. Sporadic unannounced quizzes will be given to ensure that students are current with homework assignments. Three exams and a comprehensive final exam will be given.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

A First Course in Differential Equations by J. David Logan, Springer.

**10. Subsequent Courses:**

Increased mathematical maturity will make all upper division mathematics courses more accessible following the completion of MA*301. Both M*A375 and MA*461 build directly on topics from MA*301.

**11. Additional Course Descriptors, if any:**

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*302

Course Title: Foundations of Higher Mathematics Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP

Course counts as: _____ general education requirement
x part of Mathematics major program
_____ elective

**1. Catalog Description:**

This course provides a careful introduction to mathematical reasoning using definitions and proofs. Topics covered include set theory, logic and mathematical induction. Prerequisite: Grade of C or better in MA*205.

**2. Course Content:**

See attached course topics.

**3. Rationale for the Course:**

This course serves as a bridge from the technique-oriented courses such as calculus to the proof-oriented upper-level mathematics offerings. Students need a course which concentrates on the understanding and creation of proofs and the basic tools needed in the upper-level courses, such as logic and set theory, so that they will be ready to apply the understanding and tools to the study of other mathematical ideas.

**4. Skills and Background Required or Expected:**

Students should have some mathematical maturity and exposure to rigorous mathematics, such as is provided in the calculus sequence. No specific prerequisite knowledge is necessary for MA*302.

**5. Teaching Methodologies and Anticipated class size:**

This course will require student's active participation in class. Formal lecturing will be minimized, though some small amount will take place. An emphasis on group creation of proofs should encourage a large amount of class participation. In view of this, an optimal size would be 12 or less.

**6. Learning Objectives for Students:**

- Implement set theoretic concepts to describe relations between mathematical objects.
- Analyze, recognize and design the logical structure of mathematical statements.
- Read, understand and explain complex mathematical proofs.
- Invent and write down sound mathematical proofs utilizing various methods, including mathematical induction.
- Demonstrate knowledge of functions, relations, orders and cardinalities.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Problems sets and exams will ask students to provide proofs, explain topics, check examples, give definitions, and otherwise exhibit their understanding of the topics listed as learning objects. Grades on problem sets will make up 40% of the course grade and each of two in-class exams will be worth 155. The final exam will count 15%, and 15% is allotted to class participation. A grand average of at least 90% will guarantee an A, 80% a B, 70% a C, and 60% a D. It may be, for example, that an 88% will be an A, but this is up to the instructor's judgment.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

A Discrete Transition to Advanced Mathematics by Bettina Richmond and Thomas Richmond, 1st edition, Brooks/Cole.

**10. Subsequent Courses:**

Students would be well-advised to take MA*302 before attempting any upper-level mathematics course. Indeed, MA*302 is one of the prerequisites for each MA*411, MA*421, and MA*441.

**11. Additional Course Descriptors, if any:**

Problems from the textbook will be assigned when the class is prepared for them and will be collected and graded weekly. These will include proofs and examples. Written work will be evaluated on the basis of mathematical correctness, clarity, grammar, spelling and style. Students will often be asked to present proofs and examples on the board in class as well as to engage in discussion of such presentations.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*341

Course Title: Linear Algebra Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F

Course counts as: ____ general education requirement
x part of Math major program
____ elective

**1. Catalog Description:**

Topics covered include vectors, vector spaces, subspaces, linear dependence, matrices, determinants, Euclidean spaces, and linear equations. Prerequisite: Grade of C or better in MA*204.

**2. Course Content:**

Matrices, determinant function, vector spaces and subspaces, linear independence, basis and dimension, linear transformations, eigenvalues and eigenvectors, applications.

**3. Rationale for the Course:**

This course satisfies the major requirements for Math and Computer Science. The course is useful for the Engineering and Physical Science disciplines.

**4. Skills and Background Required or Expected:**

Grade of C or better in MA*204.

**5. Teaching Methodologies and Anticipated class size:**

Lecture/recitation. Class size of 15 anticipated. Homework assigned regularly. Problem solving.

**6. Learning Objectives for Students:**

- Use basic algorithms employed in linear algebra (e.g. Gauss-Jordan elimination).
- Demonstrate knowledge of the theory and application of vectors, matrices, vector spaces and linear transformations.
- Apply linear algebra for problem solving by demonstrating the ability to adapt the conceptual tools they are given to different kinds of problems.
- Make use of appropriate computer software now available as an aid in calculations.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Elementary Linear Algebra, 8th edition, Wiley and sons.

**10. Subsequent Courses:**

The concepts covered in this course have important applications in various branches of Mathematics, Physics, Engineering, Computer Science, Social Sciences, Econometrics and Operations Research.

**11. Additional Course Descriptors, if any:**

Students are expected to attend class regularly. However, attendance does not affect final grade computation.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*351

Course Title: Discrete Structures Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

**1. Catalog Description:**

This course introduces the rigorous theoretical framework within which ideas about computer science can be expressed. Prerequisite: Grade of C or better in MA*204.

**2. Course Content:**

Topics treated in this course include: logic, sets, proofs, algebraic systems, elementary and advanced counting, relations, graph theory (including trees), Boolean algebra, formal languages, and finite state machines.

**3. Rationale for the Course:**

The mathematical tools employed in computer science are very different from those needed in physics and engineering. Any student who is planning to continue in computer science needs to be familiar with discrete mathematics and logic. It is also desirable for mathematics majors to see examples of applications and mathematics in areas different from those related to calculus.

**4. Skills and Background Required or Expected:**

The student is expected to have the mathematical maturity and skills required to pass MA*204.

**5. Teaching Methodologies and Anticipated class size:**

Much or most of class time will be devoted to discussion of assigned problems and theorems. Students will regularly turn in written assignments and will make oral presentations of some of these assignments to the other students in the class.

**6. Learning Objectives for Students:**

- Demonstrate the ability to perform calculations on population growth, using both the finite and the continuous models (logistic equations); a term paper on the problem of world population will be assigned.
- Exhibit facility in mathematical problems possessing symmetries, both geometric and algebraic.
- Show conceptual familiarity with concepts of descriptive statistics and performance of practical calculations in inferential statistics, to include hypothesis testing.
- Show evidence of a significant familiarity with the problems of graph theory, to include Euler and Hamilton circuits.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs**.**

**7. Methods of Evaluation**

Assessment of performance will include graded homework assignments in-class (4-tests + final), and one term paper.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Excursions in Modern Mathematics by Peter Tannumbaum, 6th edition, Prentice Hall.

**10. Subsequent Courses:**

This course is required of all computer science majors. In particular, it is a prerequisite for CS*410.

**11. Additional Course Descriptors, if any:**

N/A

The Calendar of Assignments, Assessment Project, a Statement Concerning the "Americans with Disabilities Act" (ADA) Accommodations for Students, Attendance and Grading Policies are to be included in the course syllabus.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*375

Course Title: Numerical Methods and Software Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP/Odd Years

Course counts as: _____ general education requirement
x part of Math major program
_____ elective

**1. Catalog Description:**

This course is an introduction to such topics as interpolation, integration, solutions of linear systems of equations, solutions of linear and nonlinear equations, and solutions of ordinary differential equations. It includes the use of numerical software libraries. Prerequisite: Grade of C or better in MA*204 and MA*341, CS*201 or CS*202.

**2. Course Content:**

The course covers: Computer Arithmetic and Computational Errors; Liner Systems of Equations; Interpolation; Numerical Quadrature; Ordinary Differential Equations.

**3. Rationale for the Course:**

This course is intended primarily for a course in numerical methods for use in scientific computation. It covers several important topics in the mathematics of computation, with emphasis on quality, state-of-the-art subroutines and their application to typical problems. With increased recognition of the importance of writing, testing, and distributing quality mathematical software, the subroutines that are made available for the course in our math/computer science lab are among the best currently available and should be used extensively by the reader both during and after any course in numerical computing. It is also a supplement to a more theoretical course numerical analysis.

This course is a recommended course for the computer science degree program and the applied mathematics programs. It is an excellent course for students majoring in the natural sciences and engineering.

**4. Skills and Background Required or Expected:**

The student should be familiar with the basic content of calculus as would be required by the completion of MA*203. The student should also have some working knowledge of the FORTRAN programming language.

**5. Teaching Methodologies and Anticipated class size:**

The anticipated class size is between 8-12. The teaching method will be primarily lecture and discussion. Out-of-class work which includes extensive use of our computer lab is assigned for each concept covered.

**6. Learning Objectives for Students:**

- Analyze the efficiency of numerical methods and estimate computational error patterns.
- Utilize matrix algebra for solving linear systems of equations by elimination and iteration.
- Create best fitting curves to data and compute liner regression by the least squares methods.
- Approximate integrals by the Newton Coates formulas, the trapezoid rule and Romberg's method.
- Design and implement MATLAB programs and M-files to solve numerical problems.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

There will be a midterm and a final exam. The exams will be based on the material covered and the assignments. The course grade will be based on these exams and homework assignments (50% of exam mean plus 50% of homework mean). The following breakdown will be used for determination of grades (all grades will be rounded off to the nearest integer):

| Range | Letter Grade |
|---|---|
| 90% - 100% | A |
| 80% - 89% | B |
| 70% - 79% | C |
| 60% - 69% | D |
| $\leq$ 59% | F |

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Introduction to MATLAB with Numerical Preliminaries by Alexander Stanoyevitch.

**10. Subsequent Courses:**

There are several subsequent courses such as our MA*460 and MA*461. This course also lays the groundwork for several courses devoted to special topics in numerical analysis such as numerical solution of differential equations, interpolation theory, and approximation theory. Students who take this course are usually diverse: mathematics, engineering, science, and computer science, undergraduates, as well as graduate students from various disciplines. Thus, this course should also prepare students for several courses offered by these disciplines.

**11. Additional Course Descriptors, if any:**

N/A.

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*385

Course Title: Applied Statistics Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: F/SP

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

**1. Catalog Description:**

This course covers: statistical inference, sampling theory, hypothesis testing, correlation, and non-parametric statistics as applied to the social, life and physical sciences and to business. Prerequisite: Grade of C or better in MA*151 or equivalent course.

**2. Course Content:**

Confidence Intervals for
Confidence Intervals for
Hypothesis tests: z, t, Chi-sq, F
Two sample t-tests
t-test for related samples
Regression Analysis
ANOVA for k> 2 samples and Bonferroni t-tests
Chi-squared Contingency table test
Non-parametric tests

**3. Rationale for the Course:**

Applied Statistics covers the important field of data processing analysis. This process is a basis for good decision making.

**4. Skills and Background Required or Expected:**

MA*151 Introductory Statistics is a prerequisite for the course.

**5. Teaching Methodologies and Anticipated class size:**

Lecture, Assignments, Project and Computer Package Laboratory Exercises. Class size of 25 students.

**6. Learning Objectives for Students:**

- Determine the point and interval estimates of population parameters.
- Perform steps for significance tests about the hypothesis of one or two populations.
- Perform an ANOVA and subsequent tests for multiple comparisons.
- Construct a chi-square table and perform chi-square tests.
- Clarify the difference between nonparametric statistics and parametric statistics.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

| | |
|---|---|
| 2 Mid-term Exams | 40% |
| Homework Assignments and Lab Exercises | 20% |
| Project | 10% |
| Final Exam | 30% |

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

The required text is currently "Elementary Statistics: A Step by Step Approach with CD-ROM, 5th Edition, by Allan Bluman, Mc-Graw-Hill Publishing.

**10. Subsequent Courses:**

MA*451 Probability and Statistics and specialized courses including Bio-Statistics, Agricultural Statistics, Educational Testing Theory.

**11. Additional Course Descriptors, if any:**

Inferential Statistics and Probability (including p-values)

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*411

Course Title: Introduction to Abstract Algebra Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP/Even Years

Course counts as: _____ general education requirement
x part of Math major program
_____ elective

**1. Catalog Description:**

This course offers a study of modern algebra with topics from group theory and ring theory. Prerequisite: Grade of C or better in both MA*205 and MA*302.

**2. Course Content:**

A review of fundamental concepts: sets, mappings, equivalence relations, and operations.
Theory of rings: definition of a ring and examples, forming sums and product rings, homorphisms and isomorphisms of rings, ideals, quotient rings, integrals domains, fields.
Theory groups: definition of a group, examples including permutation groups, homomorphisms and isomorphisms of groups, cyclic groups, Cosets and Lagrange's theorem, and structure theorems of finite groups as time permits.

**3. Rationale for the Course:**

The basic content of the course is needed by any student who is planning to continue in mathematics. The ideas introduced here provide a foundation for work in discrete mathematics. More generally, students are presented with an important paradigm as they are exposed to the sustained development of a significant mathematical area defined by axioms using theorems and proofs. In the process, students are encouraged to make their own evaluation of the correctness of mathematical assertions.

**4. Skills and Background Required or Expected:**

The student will be expected to have had some experience with the use of theorems and proofs in mathematical exposition as would be required by MA*302.

**5. Teaching Methodologies and Anticipated class size:**

The class size should be small. Students will need a great deal of feedback if they are to refine their ability to analyze the validity of a proof and learn to use mathematical language precisely enough to communicate their ideas. Much or most of class time will be devoted to discussion of assigned problems and theorems. Students will regularly turn in written assignments and will make oral presentations of some of these assignments to the other students in the class. Work involves reading, writing, and ascertaining the correctness of mathematical assertions.

**6. Learning Objectives for Students:**

- Determine and verify whether a given abstract structure is a group, a ring, or neither of the two
- Recognize and apply the different ways of obtaining new structures from given ones like taking subgroups, subrings, subfields, or forming direct sums/products
- Solve problems dealing with concrete groups like cyclic groups and permutation groups by applying the intrinsic properties of these groups
- Compare algebraic features of mathematical systems through the use of homomorphism or

isomorphism

- Prove general statements about properties of groups and rings by using deductive reasoning that proceeds from the defining axioms or from previously established theorems.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

There will be two exams during the semester and a final. The exams will be based on the material treated in the assignments. The course grade will be based on grades on these exams and on homework assignments which will include both written and oral presentations. Class participation will also count.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Contemporary Abstract Algebra, $6^{th}$ edition, Joseph Gallian, Houghton-Mifflin Company.

**10. Subsequent Courses:**

The skills developed in this course will make subsequent upper level math courses more accessible and improve the depth of understanding of the student in those courses.

**11. Additional Course Descriptors, if any:**

N/A

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*421

Course Title: Introduction to Analysis I Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: F/Even Years

Course counts as: ____ general education requirement
x part of Math major program
____ elective

**1. Catalog Description:**

This is the first course in a two-semester sequence designed to provide an introduction to the rigorous study of the foundations of calculus. Topics covered include the completeness of the real numbers, elementary topology, continuous functions, and numerical sequences and series. Prerequisite: A Grade of C or better in MA*205 and MA*302.

**2. Course Content:**

A review of set theory.
Properties of the real numbers.
Basic topology.
Continuity.
Numerical sequences and series.

**3. Rationale for the Course:**

Freshman and sophomore level courses in calculus are primarily aimed at developing a working knowledge of the subject with emphasis placed on skills needed in applications. The purpose of this course is to introduce students to the mathematical methods of analysis which provide the theoretical basis of calculus. In the process, students are encouraged to make their own evaluation of the correctness of mathematical assertions.

The basic contents of the course is needed by any student who is planning to continue in mathematics. The ideas here provide a foundation for all work in continuous mathematics. More generally, students are presented with an important paradigm as they are exposed to the sustained development of a significant mathematical area defined by axioms using theorems and proofs.

**4. Skills and Background Required or Expected:**

The student should be familiar with the basic content of calculus as would be required by the completion of MA*205. The student will be expected to have had some experience with the use of theorems and proofs in mathematical exposition as would be required by MA*302.

**5. Teaching Methodologies and Anticipated class size:**

The class size should be small. Students will need a great deal of feedback if they are to learn how to reliably analyze the validity of a proof and learn to use mathematical language precisely enough to communicate their ideas. Much or most of class time will be devoted to discussion of assigned problems and theorems. Students will regularly turn in written assignments and will make oral presentations of some of these assignments to the other students in the class. Work involves reading, writing, and ascertaining the correctness of mathematical assertions.

**6. Learning Objectives for Students:**

- Demonstrate familiarity with the limits, sequences, series and continuous functions.
- Refine skills in communicating mathematics effectively by participating in classroom discussions and presenting work orally in class.
- Refine skill in reading, writing, and ascertaining the validity of proofs.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs**.**

**7. Methods of Evaluation**

There will be two exams during the semester and a final. The exams will be based on the material treated in the assignments. The course grade will be based on grades on these exams and on homework assignments which will include both written and oral presentations. Class participation will also count.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Elementary Analysis, $8^{th}$ edition, by Kenneth Ross. Spinger-Verlag.

**10. Subsequent Courses:**

MA*422. Both the information presented and the skills developed in this course will make subsequent upper level math courses more accessible and improve the depth of understanding of the student in those

**11. Additional Course Descriptors, if any:**

N/A

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: COLLEGE OF NATURAL AND APPLIED SCIENCES Course Number: MA*422

Course Title: Introduction to Analysis II Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: SP/Odd Years

Course counts as: _____ general education requirement
x part of Mathematics major program
_____ elective

**1. Catalog Description:**

This is the second course in a two-semesters sequence designed to provide and introduction to the rigorous study of the foundations of calculus. Topics covered include differentiation, integration, sequences and series of functions. Prerequisite: A Grade of C or better in MA*421.

**2. Course Content:**

- Differentiation
- Integration
- Sequences and series of functions
- An introduction to measure theory and the Lesbesgue integral as time permits

**3. Rationale for the Course:**

Freshman and sophomore level courses in calculus are primarily aimed at developing a working knowledge of the subject with emphasis placed on skills needed in applications. The purpose of this course is to introduce students to the mathematical methods of analysis which provide the theoretical basis of calculus. In the process, students are encouraged to make their own evaluation of the correctness of mathematical assertions.

The basic contents of the course is needed by any student who is planning to continue in mathematics. The ideas here provide a foundation for all work in continuous mathematics. More generally, students are presented with an important paradigm as they are exposed to the sustained development of a significant mathematical area defined by axioms using theorems and proofs.

**4. Skills and Background Required or Expected:**

The student should have completed MA*421.

**5. Teaching Methodologies and Anticipated class size:**

The class size should be small. Students will need a great deal of feedback if they are to learn how to reliably analyze the validity of a proof and learn to use mathematical language precisely enough to communicate their ideas. Much or most of class time will be devoted to discussion of assigned problems and theorems. Students will regularly turn in written assignments and will make oral presentations of some of these assignments to the other students in the class. Work involves reading, writing, and ascertaining the correctness of mathematical assertions.

**6. Learning Objectives for Students:**

- Demonstrate familiarity with the limits, sequences, series and continuous functions.
- Refine skills in communicating mathematics effectively by participating in classroom discussions and presenting work orally in class.
- Refine skill in reading, writing, and ascertaining the validity of proofs.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

There will be two exams during the semester and a final. The exams will be based on the material treated in the assignments. The course grade will be based on grades on these exams and on homework assignments which will include both written and oral presentations. Class participation will also count.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Elementary Analysis, $8^{th}$ edition, by Kenneth Ross. Spinger-Verlag.

**10. Subsequent Courses:**

Both the information presented and the skills developed in this course will make subsequent upper level math courses more accessible and improve the depth of understanding of the student in those courses.

**11. Additional Course Descriptors, if any:**

N/A

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*431

Course Title: Topics in Advanced Mathematics Credit Hours: 3 crs.

Date of Final Approval: Semester Offered: As Resources Permits

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

1. Catalog Description:

This course offers selected topics in advanced mathematics such as topology, mathematical induction, non-Eucledian geometries. Different subject matter may be repeated for credit. Prerequisites: Grades of C or better in MA*205 and MA*302.

**2. Course Content:**

The proposed topic is the history of mathematics. The course will be designed to provide a broad survey of this subject. The following is a list of basic topics drawn from the proposed text:

- Ancient Mathematics
- The Beginnings of Mathematics in Greece
- Archimedes and Apollonius
- Mathematical Methods in Hellenistic Times
- Medieval Mathematics
- Medieval China and India
- The Mathematics of Islam
- Mathematics in Medieval Europe
- Early Modern Mathematics
- Algebra in the Renaissance
- Mathematical Methods in the Renaissance
- Geometry, Algebra, and Probability in the Seventeenth Century
- The Beginnings of Calculus
- Analysis in the Eighteenth Century
- Probability, Algebra, and Geometry in the Eighteenth Century
- Algebra in the Nineteenth Century
- Analysis in the Nineteenth Century
- Geometry in the Nineteenth Century
- Aspects of the Twentieth Century

Clearly, we will not be able to cover all of these topics in depth. The basic emphasis of the course will be on the history of mathematics that is relevant to the development of calculus. Also one of the attractions of the text is that it provides opportunities to discuss mathematical developments outside of the Western tradition. As time permits it would be desirable to treat some of the history behind important developments in modern mathematics.

**3. Rationale for the Course:**

Most students majoring in mathematics at UOG are planning to go into secondary level teaching. A number of our students have expressed an interest in a course on the history of mathematics. While such a course is not particularly critical to the needs of students planning to do graduate work in mathematics, such a course would clearly be useful to a potential teacher. Most course work in mathematics neglects the

historical context in which the techniques and ideas were produced. A history course provides an opportunity to give life to the student's knowledge of mathematics by providing both personal and cultural background. Such a course would also provide our students with more background on how mathematics is used and why it has developed as it has. Besides serving as an enrichment tool such a course would also be a good setting in which to develop and refine students' skills in technical exposition.

**4. Skills and Background Required or Expected:**

Students will be expected to have completed the usual prerequisites for 400-level mathematics courses at UOG: a C or better in both MA205, Multivariable Calculus, and MA302, Foundations of Higher Mathematics.

**5. Teaching Methodologies and Anticipated class size:**

The expected class size is less than 20. The course will be taught using a lecture/ discussion format. Much of the work in class will revolve around discussion of the text and problems from the text. There will be probably be supplementary tracts provided to the students to supplement the text as regards more recent developments in mathematics. Students will be assigned or (in consultation with the instructor) choose topics upon which they will be expected to give oral or written reports.

**6. Learning Objectives for Students:**

- Demonstrate the ability to read and understand mathematics proofs by reading and analyzing proofs in class, in homework assignments, and in exams.
- Demonstrate the ability to create and write mathematics proofs by writing and explaining proofs in class, in homework assignments, and in exams.
- Demonstrate the ability to use the techniques and theory covered to establish more complex results by presenting them in class, by completing homework assignments and taking exams.
- Demonstrate effectively the ability to communicate mathematics verbally by reading and writing mathematics and by presenting work orally in class, turning in homework assignments on topics covered and taking exams.
- Demonstrate knowledge of the basic axioms and theory underlying calculus by presenting them in class, by completing homework assignments and taking exams.
- Refine skills in reading, writing, and ascertaining the validity of mathematical proofs.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

There will be two midterm exams and a final which concentrate on the basic facts treated during the course. Assigned work will include problem sets and a couple of short oral or written assignments which will require students to use available facilities like the library and the Internet to research given topics. There will be a major term paper required which will treat a topic approved by the instructor. This paper should not be purely biographical nor be restricted to a purely mathematical problem.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

A History of Mathematics: An Introduction by Victor J. Katz,

**10. Subsequent Courses:**

There are several subsequent courses. Our MA*461 is one of them. This course also lays the groundwork for several courses such as functional analysis (or operator theory), linear analysis, numerical ordinary differential equations, numerical partial differential equations, etc. It should also prepare students majoring in physics and engineering.

**11. Additional Course Descriptors, if any:**

N/A

# UNIVERSITY OF GUAM
# COURSE OUTLINE FORM

College: College of Natural and Applied Sciences Course Number: MA*453

Course Title: Operations Research Models Credit Hours: 3 crs.

Date of Final Approval: _____ Semester Offered: As Resources Permits

Course counts as: _____ general education requirement
_____ part of _____ major program
__x__ elective

**1. Catalog Description:**

Operations research models are designed to optimize, maximize, or minimize real world processes. Computer methods and packages are included for linear and dynamic programming, life and death processes, P.E.R.T. – C.P.M., trend analysis and queuing theory. Prerequisite: MA*341 and MA*385.

**2. Course Content:**

The course covers:

- Linear programming
- P.E.R.T. – Critical Path Method
- Markovian Life and Death Professes
- Queuing models
- Queuing networks
- Dynamic programming

**3. Rationale for the Course:**

Operations Research is a discipline evolved in connection with efforts to apply mathematical technique variable and include allocation, competition, queuing, inventory and production. This subject matter is of interest to students of business, science, or mathematics who want to learn about an important area of applied mathematics.

**4. Skills and Background Required or Expected:**

Students are expected to have a background in college-level algebra and advanced statistics

**5. Teaching Methodologies and Anticipated class size:**

The course is taught using lecture, assignments, projects and computer package laboratory exercises. Anticipated class size is 15.

**6. Learning Objectives for Students:**

- Formulate linear programming model for variety of situations. Solve LP by using graphical methods, simplex method or duality. Perform sensitivity and post optimality analysis.
- Identify the main features of a dynamical programming problem. Perform forward and backward recursion in DP.
- Analyze the Markov chains and its long run behavior with applications.
- Define the queuing systems, identify the service and arrival distributions, calculate the steady state.

Note: With Program Faculty Consultation, an instructor may add additional SLOs to the above Program Faculty approved SLOs.

**7. Methods of Evaluation**

Students are evaluated on the basis of exams, homework assignments, lab exercises, attendance, and a project. Graduate students carry out an additional research project and present their conclusions both orally and in written form.

**8. Methods for Student Learning Outcomes Assessment:**

Depending on Instructor and Program Faculty, any one or more of the following may be selected: Pre/Post Test, Course embedded questions; Standardized exams; Portfolio Evaluation; Direct Observation; and Capstone Course Evaluation.

**9. Required and Recommended Texts or Study Guides:**

Introduction to Operations Research, 8th edition by Hillier.

**10. Subsequent Courses:**

MA*451.

**11. Additional Course Descriptors, if any:**

N/A.