

Mathematics

Department Chair
Roger Griffiths, Ph.D.

FACULTY

Professors:
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INTRODUCTION

The department offers degrees in Mathematics and Information Technology. The goal of the Mathematics/ Information Technology Department at Mercyhurst is to provide a student with the knowledge essential to the pursuit of a career in government, industry, commerce or education, or for entrance into graduate school for further study.

MISSION STATEMENT

The Department of Mathematics and Information Technology is committed to:

Preparing its mathematics graduates to pursue certification in secondary mathematics education or to succeed in graduate programs in mathematics, applied mathematics, statistics, operations research, and related disciplines;

Preparing its information technology graduates for immediate employment in the technology sector or for continued graduate study in a computing-related discipline;

Providing Mercyhurst University students in Biology, Biochemistry, Chemistry, Physics, Forensic Science, and Public Health the mathematics education and resources they need to be successful in their chosen fields;

Providing Mercyhurst University students in Intelligence Studies computing education opportunities and resources related to their discipline;

Providing Mercyhurst University students in Graphic Design, Art, Music, and Dance computing education opportunities and resources related to their disciplines;

Providing all Mercyhurst students with opportunities to improve their basic mathematics and computing skills;

Providing all Mercyhurst students with opportunities to broaden their appreciation of mathematics and computing;

Contributing to the advancement of mathematics, statistics, and computer science through published

research, conference presentation, and scholarly collaboration;

Sharing educational innovation through publication and conference presentation.

PROGRAM STUDENT LEARNING OUTCOMES

Mathematics Major

A graduate earning a B.A. in mathematics from Mercyhurst University must be able to:

Derive equivalent algebraic and analytic expressions from other such expressions using sound mechanical technique;

Solve problems in mathematics which require conceptual understanding for their solution;

Write mathematics correctly;

Prove mathematical statements.

INFORMATION TECHNOLOGY MAJOR

A graduate earning a B.A. in information technology from Mercyhurst University must be able to:

Program in a high-level, object-oriented language;

Query, modify, manage, and design databases;

Analyze computer networks and solve networking problems;

Construct well-designed, usable websites, with content, presentation, and functionality separated, adhering to web standards and web accessibility guidelines.

MAJORS MINORS AND CONCENTRATIONS

Majors

Mathematics
Information Technology

Minors

Mathematics
Information Technology

MATHEMATICS DEGREE REQUIREMENTS (BACHELOR OF ARTS)

MATH 170 Calculus I	4 credits
MATH 171 Calculus II	4 credits
MATH 150 Linear Algebra	3 credits
MATH 233 Calculus III	4 credits
MATH 240 Differential Equations	3 credits
MATH 245 Geometry	3 credits
MATH 250 Numerical Methods	3 credits
MATH 265 Transition to Advanced Mathematics	3 credits
MATH 280 Modern Algebra I	3 credits
MATH 280 Modern Algebra II	3 credits
MATH 291 Statistical Analysis	3 credits
MATH 370 Advanced Calculus	3 credits

It is further recommended that the Mathematics major obtain a minor or (preferably) a major in an additional discipline.

All Mathematics majors must maintain a mathematics GPA of 2.0 or higher. A student who does not satisfy this requirement may be dismissed from the major and/or prohibited from graduating with the major. A student who receives a C or below in MATH 233 Calculus III must have the department's permission to continue in the major or minor.

MATHEMATICS MINOR REQUIREMENTS

MATH 170 Calculus I	4 credits
MATH 171 Calculus II	4 credits
MATH 233 Calculus III	4 credits
MATH 150 Linear Algebra	3 credits

FOUR courses from the following:

MIS 126 Programming I	4 credits
MATH 240 Differential Equations	3 credits
MATH 245 Geometry	3 credits
MATH 250 Numerical Analysis	3 credits
MATH 265 Transition to Advanced Mathematics	3 credits
MATH 280 Modern Algebra I	3 credits
MATH 281 Modern Algebra II	3 credits
MATH 291 Statistical Analysis	3 credits
MATH 370 Advanced Calculus	3 credits
PHYS 201 General Physics I (with lab)	4 credits
PHYS 202 General Physics II (with lab)	4 credits
MATH 400 Topics in Mathematics (may be repeated)	3 credits

MATHEMATICS WITH SECONDARY EDUCATION CERTIFICATION

PROGRAM DIRECTOR: Mr. Patrick Kelly
The Mathematics Education program at Mercyhurst University follows a two-step process designed to give students strong content knowledge before they master the pedagogical tools necessary to become expert teachers at the secondary level (grades 7-12). In completing this program the student earns a master's degree in addition to the completion of a bachelor's degree.

Students interested in the program will first pursue a B.A. in Mathematics by complying with the requirements outlined herein. Upon completion of the undergraduate mathematics degree, the student may then enroll in the Master of Science in Secondary Education: Pedagogy and Practice program (see Graduate Programs Catalog). Teaching certification is not earned until the completion of the master's degree.

A unique benefit of this program is that students intending to complete their undergraduate mathematics degree at Mercyhurst may seek enrollment in the 4+1 program, in which they can complete the master's degree under an intensive, one-year curriculum. This 4+1 program allows students to earn a B.A. in Mathematics, earn an M.S. in Secondary Education, and become certified to teach at the secondary level, in a five-year period.

Students in the 4+1 program must maintain a G.P.A. of 3.0, complete a Sophomore Review, pass the PRAXIS I & II exams, and complete two education courses (EDUC 210 Comparative Issues in Education and WL 101 Culturally and Linguistically Diverse Learners) before acceptance into the graduate program. Each student will work with the program coordinator to successfully meet all of these goals during the established timeline.

Students who have earned a mathematics degree from another institution will have their work evaluated against Mercyhurst's requirements for the B.A. in Mathematics before being accepted into the master's program.

INFORMATION TECHNOLOGY MAJOR REQUIREMENTS (BACHELOR OF ARTS)

MIS 126 Programming I	4 credits
MIS 140 Computer Operations	3 credits
MIS 180 Linux Operating Systems	3 credits
MIS 226 Programming II	3 credits
MIS 260 Networks	3 credits
MIS 280 Introduction to Internet Programming	4 credits
MIS 350 Database Management	3 credits
MIS 370 Client-Side Programming	4 credits
MIS 370 Server-Side Programming	4 credits

Department Approved MIS elective

An internship may be used for one or more of the above electives.

All Information Technology majors are encouraged to pursue an additional minor or (preferably) an additional major in another discipline.

All Information Technology majors must maintain a GPA in the major of 2.0 or higher. A student who does not satisfy this requirement may be dismissed from the major and/or prohibited from graduating with the major.

INFORMATION TECHNOLOGY MINOR

MIS 126 Programming I	4 credits
MIS 260 Networks	3 credits
MIS 350 Database Management	3 credits

Department Approved MIS elective

Department Approved MIS elective

An internship may be used for one or more of the above electives.

COURSE DESCRIPTIONS**MATH 099. BASIC MATHEMATICS**

This course emphasizes the acquisition and development of basic mathematical, geometric and algebraic skills. This course involves teaching the skills of problem solving; the skills for interpreting data involving graphs and tables; and the skills for working with basic algebra. Credits do not count towards graduation. **3 credits.**

MATH 102. ELEMENTARY ALGEBRA

The course deals with the fundamental operations of algebra and the applications of these operations. Number systems, fractions, linear equations, linear inequalities, graphs, exponents and polynomial expressions are studied. No student with two or more years of secondary mathematics should take this course. Does not meet the mathematics core requirement. **3 credits.**

MATH 109. STATISTICS

This course is an introduction to the uses of statistics and probability as decision and problem solving tools. Topics included are: measures of central tendency; variability; probability; counting, binomial distribution; normal distribution; confidence intervals correlation and regression; hypothesis testing, statistical inference, sampling techniques and experimental design. **3 credits.**

MATH 110. MATHEMATICS APPLICATIONS

Mathematics Applications invites students to experience mathematics in the context of its relationship to a single

field of application, such as Art, Music, Sports, or Politics and Elections. Specifically, we will discuss functions, graphs, trigonometry, probability, statistics, and logic. The goal is to help students see the extent to which mathematics is bound to areas of their interest and therefore awaken in them a new interest in the subject. There are no prerequisites for this course. **3 credits.**

MATH 111. COLLEGE ALGEBRA

A course in algebra fundamentals, topics include sets, relations, functions, exponents and radicals, equations, inequalities, polynomial and rational functions, exponential functions, logarithmic functions, and graphing techniques. Prerequisite: MATH 102 or EQUIVALENT. **3 credits.**

MATH 112. TRIGONOMETRY AND FUNCTIONS

This course will include a further exploration of functions, followed by additional topics in trigonometry. A student may take MATH 112 without taking MATH 111. The student must have knowledge of the topics listed in MATH 111. Prerequisite: MATH 111 or EQUIVALENT. **3 credits.**

MATH 118. MATHEMATICS FOR THE NATURAL SCIENCES

This course has been designed for students who wish to take calculus, but who are not prepared for college calculus based on our mathematics placement exam and department recommendation. Topics will include fundamental concepts of college algebra, pre-calculus, and a preparation for calculus. More specifically; the topics will include factoring, integer and rational exponents, simplifying algebraic expressions, function notation, polynomial and rational functions. While many of the topics covered are similar to those in typical college pre-calculus courses, there is more theoretical coverage and emphasis, a faster pace is maintained, a greater depth of understanding is required and additional material on applications is taught. Prerequisite: MATH 112 or EQUIVALENT. **4 credits.**

MATH 139. STATISTICS FOR THE SCIENCES

This course is an introduction to statistical methods that are of particular interest to biology and natural science majors. We will explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations. We will cover descriptive statistics, elements of experimental design, probability, hypothesis testing and statistical inference, analysis of variance, correlation, regression techniques, and non-parametric statistical methods. Throughout the course the application of statistical techniques within a natural science context will be emphasized, using data from laboratory and field studies. **3 credits.**

MATH 150. LINEAR ALGEBRA

This course is an introduction to the algebra and geometry of Euclidean 3-space and its extensions to Euclidean N-Space. Topics included are systems of linear equations, determinants, vectors, bases, linear transformations and matrices. Prerequisites: MATH 170, MATH 171. **3 credits.**

MATH 160. BUSINESS/APPLIED CALCULUS

This is a one-semester course in calculus for non-science majors. Topics included are: functions, limits, continuity, derivatives and their applications, integrals and their applications, exponential and logarithmic functions.

Satisfies the core requirement in mathematics. Prerequisite: MATH 112 or EQUIVALENT. **3 credits.**

MATH 170. CALCULUS I

This is the initial course in a sequence of courses on the fundamental ideas of the calculus of one variable. It is here that truly significant applications of mathematics begin. Topics included are functions, continuity, limits, derivatives, maxima and minima and antiderivatives. Prerequisite: MATH 118 or EQUIVALENT. **4 credits.**

MATH 171. CALCULUS II

Any student who has completed Calculus I should take Calculus II to obtain a complete study of the calculus of one variable. Topics included are the integral anti-derivatives, the Fundamental Theorem, volume, length of an arc, surface area, average value, moments, integration techniques, series, sequences. Prerequisite: MATH 170. **4 credits.**

MATH 209. STATISTICS II

This course is a continuation of Statistics I. Sampling methods, design of experiments, and multiple regression are the topics which will be the focus of the course. Prerequisite: MATH 109. **3 credits.**

MATH 233. CALCULUS III

This is an introduction to the calculus of several variables. Topics selected from polar coordinates, functions of several variables, partial derivatives, multiple integrals, line integrals, surface integrals, Green's theorem and Stokes' Theorem. Prerequisites: MATH 150, MATH 171. **4 credits.**

MATH 240. DIFFERENTIAL EQUATIONS

An introduction to the basic mathematical content of ordinary differential equations and their applications. This will include analytical, qualitative, and numerical methods for ordinary differential equations. Topics include first-order and second-order equations and applications, systems of differential equations, and matrix methods for linear systems. Prerequisites: MATH 150, MATH 171, or Department Permission. **3 credits.**

MATH 245. GEOMETRY

Emphasis is given to geometry, uses of geometry in various mathematical subjects, historical aspects of geometry and mathematics, and mathematical curricular developments. The following topics are integrated into the course: Euclidean and non-Euclidean geometry, historical and cultural significance of mathematics, and mathematical software products. Prerequisites: MATH 150, MATH 171. **3 credits.**

MATH 250. NUMERICAL METHODS

This course will teach the student how to use programming skills together with mathematical software to efficiently solve a variety of problems. The primary programming language will be using the MATLAB environment. This approach will prepare the student for occasions where programming is required as well as the ability to utilize software packages such as MATLAB. A secondary objective is learning to use the markup language LaTeX. Having a laptop computer is not required but may be of great benefit for this course. Prerequisites: MATH 150, MATH 233, MIS 126. **3 credits.**

MATH 265. TRANSITION TO ADVANCED MATHEMATICS

This course is designed to facilitate the mathematics student's transition to courses requiring a higher level of

mathematical maturity. Emphasis will be on the reading and writing of proofs, and on communicating mathematically—both orally and in writing. Topics will include logic, set theory, functions, relations, and number theory. Prerequisites: MATH 150, MATH 171. **3 credits.**

MATH 280. MODERN ALGEBRA I

This is the first semester of a year-long sequence on the study of algebraic structures. Course topics include the properties of numbers, equivalence relations, groups, rings, fields, direct products, homomorphisms and isomorphisms, and the natural development of various number systems. Prerequisites: MATH 150, MATH 233, MATH 265. **3 credits.**

MATH 281. MODERN ALGEBRA II

This second semester course will build on material from Math 280, with a focus on integral domains, polynomial rings, and fields. Additional topics will include the Sylow theorems, finite simple groups, symmetry and patterns, and an introduction to Galois theory. Prerequisites: MATH 280. **3 credits.**

MATH 290. PROBABILITY THEORY

An introduction to the mathematical theory of probability including continuous distributions. Topics included are sample spaces; events; the algebra of events; combinatorial theory; probability distributions; binomial, hypergeometric, and Poisson distribution; probability densities; uniform, exponential, gamma, and normal distribution; mathematical expectation; multivariate distribution; Chebyshev's Theorem; Law of Large Numbers. Prerequisite: MATH 171. **3 credits.**

MATH 291. STATISTICAL ANALYSIS

An introduction to statistical concepts and techniques with emphasis on the underlying probability theoretical basis. Topics included are sums of random variables; moment generating functions; sampling distributions; F- and t-distributions; chi-square; point estimation; interval estimation; testing hypotheses, theory, and application; regression and correlation; analysis of variance. Prerequisites: MATH 150, MATH 233. **3 credits.**

MATH 370. ADVANCED CALCULUS

This course introduces the fundamental concepts of a function of a real variable from a rigorous point of view. Topics included are completion of the rational numbers, theory of continuous functions, theory of differentiation, theory of the Riemann integral, sequences, series. Prerequisites: MATH 150, MATH 233, MATH 265. **3 credits.**

MATH 400. TOPICS IN MATHEMATICS

Additional studies in mathematics can be arranged through independent study. Some possible areas for further study are Abstract Algebra, Geometry, Topology, Real Analysis and Complex Variables. At least one topics course is desirable for anyone wishing to pursue mathematics in graduate school. **3 credits.**

MIS 110. ADVANCED COMPUTER APPLICATIONS

This course focuses on the use of spreadsheets and databases to manage information. Topics studied include systems analysis, basic database design, and applications development using Microsoft Excel and Access. Prerequisite: Word and Excel basics. **3 credits.**

MIS 120. INTRODUCTION TO PROGRAMMING WITH 3-D ANIMATION

This course is an introduction to programming through 3D animation. Students will create their own elementary games and animations using the Alice language, and in the process they will learn the fundamentals of object-based programming. Topics include storyboarding, thinking in 3D, camera control, variables, functions, methods, logic, lists, events, interaction, and recursion. This course is open to all students. No prior programming experience is required. **3 credits.**

MIS 126. PROGRAMMING I

An introduction to computer programming, with an emphasis on the development of good programming habits and skills utilizing a modern object-oriented language. Topics will include programming basics such as loops, decisions, structures, functions, arrays, objects, classes, inheritance. Satisfies the core requirement in mathematics. **4 credits.**

MIS 130. 3D MODELING AND ANIMATION I

An introduction to 3D character modeling, rigging and animation. Topics include box and polygonal modeling, shape keys, armatures, inverse kinematics, parenting and weight painting, lip syncing key framing, walk cycles, acting for animation, and elementary video editing. Students will produce their own short animated movie. **3 credits.**

MIS 140. COMPUTER OPERATIONS

This course introduces the basics of computer architecture and how the software enables it to function. Students will gain knowledge and skill in installing and configuring computer hardware components including drives, motherboards, memory, network/communications interfaces, printers and other peripherals. Students will install and evaluate software. Students will use software utilities to do diagnostics, perform backups, and utilities for security and virus detection. Prerequisite: MIS 110. **3 credits.**

MIS 150. INTRODUCTION TO DATA SCIENCE

An introduction to Microsoft Excel and Access in a data science context. The focus will be on machine learning techniques, particularly cluster analysis, Naïve Bayes, and ensemble methods. **3 credits.**

MIS 180. LINUX/OPERATING SYSTEMS

Study of computer system administration using standalone and networked UNIX/Linux systems. Topics include system design and installation, file systems, BASH shell, user and process management, backup/restore, common administrative tasks, troubleshooting, and networking service administration. This course includes a lab intensive component. **3 credits.**

MIS 224. MOBILE APPLICATION DEVELOPMENT

In this course, students will learn to design, program, and publish mobile apps for iOS (mobile Apple devices) and Android using the Corona SDK. **3 credits.**

MIS 226. PROGRAMMING II

This course focuses on object-oriented design and programming using data structures such as arraybased lists, linked lists, stacks and queues implemented as abstract data types. Prerequisite: MIS 126. **3 credits.**

MIS 233. DIGITAL SCULPTING

A course in digital sculpting using ZBrush. Topics include organic and hard surface sculpting, ZSpheres and ZSketching, remesh and projection, polypainting, rendering, morph targets, and layers. **3 credits.**

MIS 235. 3D MODELING AND ANIMATION II

A continuation of the topics covered in MIS 130 along with additional topics. These may include non-organic modeling, lighting, UV mapping, texturing, and compositing. Students will again produce their own short animated movie. Prerequisite: MIS 130. **3 credits.**

MIS 250. WEB MAPPING

A survey of powerful, cutting-edge mapping technologies that yield high-quality displays of spatial data accessible via the web. The course includes a basic introduction to HTML, JavaScript, and CSS and then progresses to the study of the basic mapping technologies of KML, GeorSS, Geocoding, and the Google Maps and Earth API's. Some server-side coding with PHP, MySQL, and JSON may also be covered. **3 credits.**

MIS 260. NETWORKS

This is a study of the theory and utilization of computer networks. Topics include network hardware components, network standards from ISO-OSI and IEEE, networking protocols: channel access methods, Ethernet, and TCP/IP, Internet tools, peer to peer networking, network management, network routing and virtual circuits. Network software utilized in the course will include latest Microsoft server/client software and Linux. Prerequisites: MIS 110, MIS 140. **3 credits.**

MIS 280. INTRODUCTION TO INTERNET PROGRAMMING

In this course, students will learn the fundamentals of XHTML and CSS. The students will build websites with these two technologies, adhering to W3C standards. The separation of presentation from content will be a major theme of the course. Basic topics include the markup and styling of text, lists, tables, forms, and images, and CSS layout as well. Certain advanced topics, such as CSS frameworks, designing to a grid, CSS3, HTML5 and web graphics may also be covered. **4 credits.**

MIS 281. INTERNET PROGRAMMING II

A continuation of MIS 280 with further exploration of HTML5. Digital imagery with free and open-source software will also be covered. Additional topics may include mobile web development, search engine optimization, and web metrics with Google Analytics. Prerequisite: MIS 280. **3 credits.**

MIS 305. GAME PROGRAMMING

A first course in game programming with Unity. Topics include 3D concepts, scripting basics, environments, characters, interaction, collisions, triggers, rigid bodies, particle systems and animation. Prerequisite: MIS 120 or MIS 126. **3 credits.**

MIS 350. DATABASE MANAGEMENT

This is a study of the concepts, procedures, design, implementation and maintenance of a data base management system. Topics include normalization, database design, entity-relationship modeling, performance measures, data security, concurrence, integrity and Structured Query Language. Microsoft Access and SQL server will be the software used to

design and implement database concepts. Prerequisite: MIS 126. **3 credits.**

MIS 370. CLIENT-SIDE PROGRAMMING

In this course, students will learn the fundamentals of client-side web programming, creating programs executed by the web browser to make dynamic web pages and sites. Separation of content, presentation, and behavior will be a major theme of the course. JavaScript will be the language of choice, and the first half of the course will be focused on its basics. Topics will include statements and commands, data types and variables, arrays, strings, functions, and programming logic. In the second half of the course, a JavaScript framework will be introduced, and the students will use it to make their webpages dynamic and interactive. Topics will include the Document Object Model, events, photo galleries, navigation, forms, and Ajax. One popular JavaScript API, such as Google Maps, Google Earth, or YouTube may also be covered. Prerequisite: MIS 280. **4 credits.**

MIS 380. SERVER-SIDE PROGRAMMING

In this course, students will learn the fundamentals of server-side web programming, writing scripts and managing databases that generate dynamic web sites. The first part of the course will be focused on a server side scripting language and its basics. PHP will be the language of choice, and topics will include syntax, variables, strings, arrays, functions, logic, HTML forms, and includes. In the next part of the course, the students will learn the basics of SQL using the MySQL database, and in the last part of the course, PHP and MySQL will be used together. Topics will include e-commerce, security, cookies, and sessions. By the end of the course the students will have built complete applications. Prerequisites: MIS 280, MIS 350. **4 credits.**

MIS 403. SENIOR PROJECT

This is a capstone course. Emphasis will be on present-day productivity tools. Students will construct complete operational systems using a database environment whenever appropriate. Prerequisites: Senior Computer Systems Major, and permission of the department. **3 credits.**

MIS475. MIS INTERNSHIP

An individual working experience in an approved setting which utilizes information systems. Placements provide training and on-the-job education to prepare the student for work as a computer professional.

Variable credit.