

Section 2: Program Summary **Mathematics (EX): Secondary Major and Minor**

The University Detroit Mercy (UDM), a Catholic institution whose mission flows from the educational traditions of the Sisters of Mercy of the Americas and the Society of Jesus, exists to provide excellent student-centered undergraduate and graduate education in an urban context. A UDM education seeks to integrate the intellectual, spiritual, ethical, and social development of students. It emphasizes the worth of the individual. Further, the University expects its diverse graduates to be distinguished world citizens, community members, and leaders who:

- Reflect on the meaning of their lives.
 - Think and communicate clearly, imaginatively, and effectively.
 - Process the skills and competencies of a college education.
 - Understand diverse cultural heritages.
 - Have a sense of social responsibility and a desire to serve society.
- (2003-2005 Undergraduate Catalog, 89-91)*

UDM's Core Curriculum consists of a set of requirements (48 hours) based on six objectives that express, in further detail, this academic purpose. The list of approved core courses is published in the *Schedule of Classes* issued for each term. Education students taking their majors and minors in the College of Engineering and Science (CES) must complete the same Core Curriculum as all UDM students with specific recommendations from Core options in Objectives 1, 2, 3, 5 and 6; Objective 4 remains the same as the general core outline requirements. The specific CES recommendations are:

- Objective 1 Communication Skills—Take CST 101 Fundamentals of Speech and ENL 131 Academic Writing.
- Objective 2 Mathematical and Computer Skills—Take MTH 140 (or MTH 141/142 depending on the program) and Computer Science (Required course depends on program).
- Objective 3 Scientific Literacy—At least two courses must be in Natural Science. In some programs, all courses may be selected from Natural Science.
- Objective 5 Diverse Human Experience—Two courses from 5A (History and Religious Studies), 5B (Literary Experiences), and 5C (Aesthetic Experiences). Take one course from 5D (Comparative Experiences).
- Objective 6 Social Responsibility—Education students choose one course from any of the Ethics courses.)
Contemporary Socio-Political Problems—(Education students choose one course from the general core outline—depending on the program.)

The Mathematics Major and Minor content courses for Secondary Teacher Education are offered by the Mathematics and Computer Science Department in the CES. The Secondary candidates complete their degree in the College of Engineering and Science

and are advised regarding their major by the Mathematics Department and by the Education Department regarding certification requirements.

The Department of Education, housed in the College of Liberal Arts and Education (CLAE), offers baccalaureate, post-degree, and master's degree teacher education programs with State of Michigan certification in three areas: Elementary Education, Secondary Education, and Special Education. Each program requires the completion of coursework in three areas:

- University core curriculum.
- A teaching major and minor in approved academic areas.
- Professional education, including student teaching.

In addition to these programs, UDM Education Department delivers the same graduate and postgraduate certification programs to cohorts of K-12 Detroit Archdiocese teacher candidates through Experience Plus. All programs may be completed on a full or part-time basis either during the day, late afternoon, evening, or weekend. UDM majors and minors in Elementary, Special Education, and/or secondary education are completed in the following colleges and appropriate departments:

- College of Business Administration
- College of Engineering & Science (Includes Mathematics) and
- College of Health Professions
- College of Liberal Arts

The Department of Education, therefore, works closely with the faculty members throughout the University to ensure that each student is effectively advised and assisted to complete her/his Education program with a quality major and/or minor.

UDM offers initial teacher certification in Mathematics (EX) for students who wish to teach in secondary (Grades 7-12) schools. The programs are available at both the undergraduate and graduate levels. Undergraduates obtain a major or a minor in mathematics and prepare for a mathematics endorsement. At the graduate level, students earn a major or prepare for an additional endorsement. The content of the graduate and undergraduate courses is the same. For example, MTH 481 and MED 581 Modern Algebra have the same mathematics content, but requirements may differ if the student is a graduate student. The secondary Mathematics major is a program of 36 required hours with a core of 30 hours and 6 hours of electives, which is completed in the College of Engineering and Science. The Mathematics minor is a program of 20 required credit hours, including a core of 17 hours, and 3 hours of electives.

Supportive, pre-requisite, and co-requisite courses require the students to take additional Mathematics courses, which is a 20 hour required cognate. Depending on the elective chosen, Secondary Education Mathematics Majors and Minors, therefore, might also take MTH 095 Elementary Algebra (3 Credits); MTH 101 Algebra (3 Credits); MTH 141 Analytic Geometry and Calculus I (4 credits); MTH 142 Analytic Geometry and Calculus II (4 credits); and/or MTH 480 Analysis for Teachers (3 Credits). The *Michigan Curriculum Framework* for Mathematics specifies that a “mathematically powerful individual should be able to: reason mathematically; communicate mathematically; problem-solve using mathematics; and make connections within

mathematics and between mathematics and other fields.” Those standards are categorized into six strands: Patterns, Relationships, and Functions; Geometry and Measurement; Data Analysis and Statistic; Number Sense and Numeration; Numerical and Algebraic Operations and Analytical Thinking; and Probability and Discrete Mathematics. UDM students take classes that give them an in depth knowledge of these concepts and the appropriate mathematical skills to become a secondary education teacher who also makes positive contributions to society.

A. Philosophy, Rationale, and Objectives

Philosophy: The Mathematics faculty members, housed in the Department of Mathematics and Computer Science in CES, and the Education Department faculty in CLAE work together to prepare teacher education candidates for the Mathematics secondary teacher certification. The philosophies of these two departments are complementary. The Mathematics Department’s objective is to prepare secondary (7-12) teachers who have a strong background in mathematics (numeration, number theory, geometry and measurement, statistics and probability, algebra, trigonometry, and the conceptual foundations of calculus) and the pedagogical understandings to plan and implement a curriculum that is consistent with the most current thinking in mathematics education. In addition to standard topics in mathematics education, courses in statistics and computer science are available. The program is guided by the Michigan State Board of Education’s and the Michigan Department of Education’s standards, guidelines, policies, and tests as well as the curriculum guidelines of the National Council of Teachers of Mathematics.

Both departments believe that theory and scholarly research need to be placed in the proper historical, social, and political context. They seek to integrate laboratory and field experience into the learning process so that students not only learn about their discipline but also construct knowledge in a real and tangible manner. Students, thus, have the advantage of developing a knowledge and skill base which empowers them to be active, positive contributors to the local, national and global societies. In order to teach students from diverse backgrounds, socio-economic status, and abilities in urban, suburban, and rural settings, UDM Education and Mathematics faculty believe that a strong pedagogy program must be a full partner with academic knowledge.

Rationale: The role of mathematics and science in today’s complex and highly technological society is considered a critical determinant to our future as a global community. With this in mind, the faculties of the Mathematics and the Education Departments strive to provide an education which integrates the intellectual, spiritual, moral and social development of their students. This integration requires a solid base of discipline knowledge which demonstrates the interrelationships within the discipline as well as those relationships with other disciplines. It is through this kind of study that students learn and practice the knowledge and skills required to be inquiring, reflective, ethical and value-driven educators. Preparation for the Mathematics secondary teacher certification enables teacher candidates to use this knowledge and skill base to make knowledgeable, practical and creative

applications of theory as well as to identify issues and solve problems which challenge our ability to create a better world. In today’s complex world, Mathematics teachers also need to use the skills of the art and science of teaching to help their students learn how mathematics can help them to be practical and productive members of society. Competition from other countries demands that the faculty in both departments continue working to raise the standards for entry into and exit from teacher preparation programs in mathematics. The Mathematics program of studies is designed to provide the knowledge, skills, and practice that Teacher Education students need in order to be competent educators in this regard.

Objectives: The general objectives for the preparation of all secondary teacher education candidates, including those with secondary Mathematics Majors and Minors, are delineated in the “Education Department’s Conceptual Framework,” which is published annually along with the “Education Department’s Code of Ethics” in its *Teacher Education Handbook*. This “Framework,” which complements the Michigan Department of Education’s Standards for the Secondary Mathematics programs and the Entry-Level Standards for Michigan Teachers (ELSMT), identifies three dimensions of the role of teacher:

- A *scholar* who uses the research-knowledge base for teaching integrated with the liberal arts and sciences disciplines.
- An *inquirer* who is skilled in decision-making based on ethical, critical, and reflective thinking.
- A *moral agent* who values and acts according to the UDM values and the “Department of Education Professional Code of Ethics.”

These general objectives, in addition to complementing the University mission and the Mathematics department’s philosophy, reflect the key ideas expressed by the Michigan State Board of Education-January 2002 Content Guidelines/Standards (SBE Standards) and the “*Michigan Curriculum Framework Content Standards for Mathematics*”. Additionally, they are aligned with the Michigan Test for Teacher Certification (MTTC).

These content categories have been reviewed by the Mathematics and Education faculty, who believe that the Mathematics program of studies effectively prepares candidates for certification as teachers of Mathematics in the secondary classroom as follows:

Sub area	Approximate Percentage Of Questions on Test
Mathematical Processes and Number Concepts	22%
Patterns, Algebraic Relationships, and Functions	28%
Measurement and Geometry	22%
Data Analysis, Statistics, Probability, and Discrete Mathematics	28%

Mathematical Processes and Number Concepts

Understand principles of mathematical reasoning and techniques for communicating mathematical ideas.

Understand problem-solving strategies, connections among different mathematical ideas, and the use of mathematics in other fields.

Understand number systems and equivalent ways of representing numbers.

Understand number theory and operations on number systems.

Patterns, Algebraic Relationships, and Functions

Describe, analyze, and generalize mathematical patterns.

Use symbolic expressions to describe and analyze patterns of change and functional relationships.

Understand properties and applications of linear and quadratic functions, and solve related equations and inequalities.

Understand properties and applications of polynomial, rational, exponential, logarithmic, and trigonometric functions, and solve related equations and inequalities.

Understand principles and applications of differential and integrated calculus.

Measurement and Geometry

Understand attributes of measurement and measuring units.

Apply measurement principles to analyze the spatial characteristics of two- and three-dimensional shapes.

Apply geometric principles of points, lines, angles, planes, congruence, and similarity to analyze the formal characteristics of two- and three-dimensional shapes.

Apply properties of geometric transformations and coordinate and vector methods to describe geometric objects in two and three dimensions.

Data Analysis, Statistics, Probability, and Discrete Mathematics

Understand methods of collecting, organizing, and displaying data.

Understand methods of describing, analyzing, and interpreting data.

Understand methods of making predictions and inferences based on data.

Understand the theory of probability and probability distributions.

Understand principles of discrete mathematics.

B. Sequence of Courses and/or Experiences

UDM's College of Liberal Arts and Education offers baccalaureate, post-degree, and master's degree teacher education programs with State of Michigan certification in three areas: Elementary Education, Secondary Education, and Special Education.

Each program requires the completion of coursework in these areas:

- University core curriculum.
- A teaching major and a teaching minor in approved academic subject areas.
- Professional education, including field experiences and student teaching.

The UDM 48 Hour Core Curriculum is explained in the *2003-2005 Undergraduate Catalog* (89-91) and is published, with a list of approved courses for each of the six

objectives, in the *Class Schedule* for each of the three terms (16-18 Term I 2003-2005). Education students are encouraged to select courses that will complement their certification as well as their major and minor areas of study. For example: Mathematics students would be encouraged to select courses in the Math, Science, Social Studies, Literature, and the Fine Arts that would complement their Mathematics major or minor as well as any other area of study they may be pursuing. Those objective areas are:

1. Communication Skills (6 hours; 2 courses-Speech and Academic Writing).
2. Mathematical and Computer Skills (6 hours—choices in Mathematics and Computer).
3. Scientific Literacy (9 hours—choices from the Social Sciences and Natural Sciences).
4. Meaning and Value (9 hours—choices from Philosophy, Religious Studies).
5. Diverse Human Experience (12 hours—choices from Historical, Literary, Aesthetic, Comparative Experiences and Languages).
6. Social Responsibility (6 hours—choices from Ethics and Contemporary Social Problems, ranging from Philosophy, Health Services, Religious Studies across Social and Natural Sciences, Criminal Justice, Communication, Women's Studies.)

The sequence of courses listed in Form XX for the Mathematics majors and minors provides a systematic study of the fundamental knowledge of mathematics and its methods of reasoning and inquiry. A foundation is thereby established for students' future pursuits, including a career in secondary education. The core courses in the Mathematics sequence develop the students' understanding of the fundamental concepts so they are able to:

1. Exercise mathematical reasoning through recognizing patterns, make and refine conjectures and definitions, and construct logical arguments.
2. develop their own processes, concepts, and techniques for solving problems;
3. apply mathematics learned in on context to the solution of problems in other contexts;
4. function as independent learners, capable of doing and learning mathematics on their own;
5. understand and appreciate the power of mathematical language and symbolism in the development of mathematical insight;
6. communicate effectively with people who have different levels of mathematical knowledge and insight using graphical, numerical, symbolic, and verbal representations;
7. construct models to analyze real world situations, recognize and use constraints in the model and develop alternative strategies for problem solving;

8. use calculators, computers, and technology tools to construct alternative representations of mathematical concepts and problem solving strategies;
9. explore the role of mathematics in society, the connections between mathematics and other disciplines, and the contributions made by various cultures to the growth and development of mathematical ideas.

After Secondary Education majors and minors have passed either MTH 101 Algebra and its prerequisite MTH 095 Elementary Algebra or equivalent or received placement from UDM's examination equivalent score, they begin their study with MTH 140 Elementary Functions: Pre-Calculus; followed by MTH 141 Analytic Geometry/Calculus I and MTH 142 Analytic Geometry/Calculus II. In MTH 481/MED 581 Modern Algebra for Teachers and MTH 483/MED 583 Fundamental Concepts of Geometry, students attain a basic conception of abstract algebraic thinking and a clear and concise definition of geometry terms, primitive notions, and postulates. Majors may elect MTH 405 Introduction to Modern Algebra in place of MTH 481/MED 581 and MTH 402 Linear Algebra with Applications for MTH 483/MED 583. Students use calculators and other technological tools as well as complete homework, presentations, and written papers. They also demonstrate their understanding through a series of quizzes and examinations. Secondary Mathematics majors deepen and broaden their understanding in four additional courses: MTH 241 Analytic Geometry/Calculus III includes the topics of plane curves, vectors in two and three dimensions, vector-valued functions, analytic geometry and calculus in three-dimensions, polar coordinates, partial derivatives, directional derivatives and multiple integrals. MTH 480 Analysis for Teachers introduces the students to the concept of a function (polynomial, piecewise, rational, exponential, logarithmic, trigonometric) and its graph. MTH 482 Linear Algebra for Teachers or MTH 402 Linear Algebra with Applications develops the students' ability to analyze various types of application problems that can be solved with the tools and techniques of linear algebra and the proficiency to use them. MTH 484/MED 584 History of Mathematics is a seminar-styled course required of majors where both the professor and students give presentations about topics in mathematics history—evolution of mathematical thinking, early number systems to computers, and anecdotal knowledge. MTH 485/MED 585 Statistics for Teachers gives the majors a formal knowledge of statistical methods and the ways by which statistics are used to clarify and distort information. Majors must also select 6 hours, or minors 3 hours, from these electives: MTH 276 Discrete Structures, MTH 372 Differential Equations with Linear Algebra, MTH 405 Introduction to Modern Algebra I, MTH 406 Introduction to Modern Algebra II (Usually taught as a Directed Study for a student who needs the class), MTH 415 Theory of Numbers, MTH 451 Techniques of Advanced Calculus, and/or MTH 486/MED 586 Higher Arithmetic for Teachers. (*MTH 461 Transformational Geometry and MTH 462 The Projective Plane are listed as additional choices in the current catalog, but have not been taught during the past five years.*) The titles identify the subject and related topics covered in the courses. In addition to being part of the Mathematics courses, the relationship of Mathematics to the other scientific and mathematical disciplines

is addressed in the UDM Core Curriculum Requirement, particularly Objective 2—Mathematical and Computer Skills.

C. Varied Instructional Approaches

The Mathematics faculty and the Education faculty prepare students to utilize a variety of instructional approaches by modeling creative, logical, and effective teaching practices in their classes. A review of the Mathematics course syllabi reveals the range of teaching methods used by that faculty to instill the skills and knowledge of the discipline: textbooks and other readings; homework exercises and problems; lectures; discussions, including questioning and inquiring; manipulatives and hands on exercises; written papers—reflective and documented; oral presentations; use of electronic tools, computers, calculators, web sites; quizzes and examinations. Additional instructional strategies involving reflective thinking, research and writing are modeled and taught in other classes. For example, in MTH 481 Modern Algebra for Teachers, students are expected to work with colleagues on pre-class assignments for this theory-based course, but each student must turn in her/his own assignment in her/his own writing/typing and be able to explain every word of it when asked. They also write two 2000-3000 words research papers: A summary of some of George Cantor's work in set theory; A short biography and summary-of-work of a famous algebraist. In MTH 483/MED583 Fundamental Concepts of Geometry, students follow similar procedures for five exploration-styled assignments which involve project exercises that contain geometric constructions, with the students expected to draw conclusion based on what they have observed. A review of the Education Syllabi on the UDM WEB reveals a similar range of teaching methods practiced by the Education faculty. Educators also include group/team/collaborative activities, building a community of learners, both non-fiction and fiction analysis, field observations and research, written and oral presentations enhanced with electronic equipment/programs, and other education projects and assessment tools. A review of the Education Courses listed in Form XXX, the "Course Descriptions," and the course syllabi on the WEB link explicates the wide range of instructional methods taught to Secondary and Special Education teacher candidates. EDU 401/402 Introduction to Elementary and Secondary Education I provides a semester long initial field experience with the "Field Research/Case Study" where students observe and work with a teacher in their major and/or minor areas. This project allows them to observe a variety of instructional strategies and to reflect upon their effectiveness and appropriateness for their developing teaching style. EDU 469 Curriculum and Methods of Teaching in Secondary Schools I involves students in a variety of web based, observation, and performance based activities as students learn the basics about curriculum, unit, and lesson design. In EDU 471 Curriculum and Methods of Teaching in Secondary Schools II: Mathematics, students enhance their skills and instructional strategies for teaching mathematics to grades 7-12 children. Topics covered are: Activities and/or Games for the Mathematics Classroom; Using Manipulatives to Teach Mathematics, Teaching Using Graphing Calculators, Cooperative Learning as an aid to Mathematical Insight, and Using Writing To Promote Mathematical Reflection and As an Assessment Tool, and Designing a Unit plan. EDU 448 Reading in the

Content Areas also provides the opportunity for candidates to develop strategies for teaching literacy and study skills for various content areas. This class especially develops the mathematics candidates' abilities to communicate mathematical concepts and skills to other subject area specialists. In addition to a variety of technology methods used and demonstrated in all the Education courses, EDU 459 Instructional Technology and EDU 600 Computer Use in Education teach a variety of instructional approaches for using many kinds of technology to assess various learning styles of students and to accommodate those learning styles. These courses also develop the candidates' knowledge, skills, and attitudes for applying technology in education settings. As the candidates develop their assignments, the mathematics candidates focus on mathematical concepts and skills. One project has candidates from different areas developing cross-disciplinary materials. These courses were developed to address the Seventh Standard of the Entry Level Standards for Michigan teachers. SED 460 Education and Mainstreaming of Exceptional Persons or SED 560 Exceptional Persons provides candidates with knowledge about principles of mainstreaming and the instructional methodologies and approaches to meet the needs of the various exceptionalities within the "least restrictive environment" and/or the general classroom setting. Student teaching, EDU 490 Teaching in the Secondary Schools as well as SED 474 Student Teaching in Special Education: Learning Disabilities and SED 484 Directed Student Teaching in Special Education: Emotionally Impaired/Behaviorally Disordered, provide grades 7-12 real teaching experiences with both grade 7-12 cooperating teachers and UDM college supervisors. Observations early in those courses and eight seminars complement their experiences and encourage self reflection and feedback about their instructional methods in collaboration with grade 7-12 Co-operating Teachers and UDM College Supervisors.

D. Elementary and Secondary Level Preparation Differences

The differences between elementary and secondary level preparation are explicated in the separate Section 2 Program Summaries of this report. The major difference between the elementary and secondary programs is in the Mathematics content courses. Elementary candidates take two mathematical analysis courses while Secondary candidates take an elementary functions course and two or three analytic geometry/calculus courses. The Elementary candidates take two courses, which the Secondary candidates do not take, in the content of the elementary school mathematics curriculum. Elementary majors and minors do not take MTH 482 Linear Algebra for Teachers, which Secondary majors do. Secondary majors and minors also have some options for their algebra and statistics courses that Elementary majors and minors do not. Finally, the electives allowed for the Elementary elective are different from those allowed for the Secondary electives. Elementary majors only have 3 hours of electives while Secondary majors have 6 hours of electives. Except for grade level appropriate education methods course, no differences exist in the programs, Elementary or Secondary, graduate or undergraduate, in general studies or in the professional and pedagogical studies for students pursuing either a major or minor in teaching of mathematics.

E. Gender Equity, Multi-cultural, and Global Perspectives

Mathematics majors and minors learn to incorporate issues of gender equity, multicultural and global perspectives within their University Core Curriculum courses. Objective IV- Meaning and Value (9 hours), Objective V-Diverse Human Experience (9 hours) and Objective VI-Social Responsibility (5-6 hours) require all students to select classes from Philosophy, Religious Studies, History, English, Human Services, and/or the Fine Arts. Instructors in the courses of the Mathematics programs take care to provide a comfortable learning environment for those whose voices have traditionally been stifled in the physical sciences and mathematics. The College's success is documented by the National Science Foundation's recognition that the College of Engineering and Science has a highly favorable rate for admission and graduation of women. The College was sought out for recipients of Clare Boothe Luce Scholarships in Physical Sciences and Engineering; it will have two Luce Scholars in programs beginning in fall 2005. The Education Courses continue the infusion of equity issues throughout the program.

E. Multiple Methods of Student Assessment

Mathematics majors and minors learn a variety of assessment tools from personal experience in every Mathematics course; which are then adaptable to their own teaching. All Mathematics courses rely on regular quizzes and examinations to assess the students' knowledge. Homework, paper and electronic worksheets, class participation—especially questioning, and formal, projects, presentations, and short papers are regularly evaluated according to specific criteria and included as part of the final grade for the course. MTH 481 Modern Algebra for Teachers is particularly helpful for students learning appropriate assessment practices to apply in their future teaching, especially the use of reflective writing about mathematical concepts, learning, and for self assessment of individual student progress. .

The Education courses continue to model and to teach a variety of assessment processes, including authentic models and/or other alternative assessments procedures. In methods EDU 459 and 600 (Education and Technology) assignments must include assessments appropriate to the lesson's or unit's objectives and the specific content being taught. Students become familiar with a variety of electronic assessment tools and practices. EDU 469 Curriculum and Methods of Teaching in Secondary Schools provides the students with an introduction to secondary curriculum and instructional methods plus a variety of ways to assess, evaluate, and report student progress. EDU 471 Curriculum and Methods of Teaching in Secondary Schools II: Mathematics involves candidates in designing mathematics units and lessons that have well-articulated outcomes, appropriate instructional strategies, and relevant assessments. Students demonstrate their acquisition of assessment skills through written and oral presentations. They constantly practice assessment methods as they evaluate each other's presentations in the course. The evaluation forms used by the grade 7-12 Co-operating Teachers and the University Supervisors in Student Teaching (490 General Education) and 474 and 478 (Special Education) include evaluation of the assessment practices used by the student teachers to evaluate the performances of their grade 7-12 students.