

**Proposal for a curricular revision of the Mathematics Education option
of the B.S. Mathematics program at UPR Mayaguez**

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I. INTRODUCTION

A. *Name of the program to be revised and degree to be conferred*

The Department of Mathematical Sciences proposes to revise the Mathematics Education option of the undergraduate Mathematics program at UPRM. Students who complete the current program receive a Bachelor of Science degree in Mathematics with a concentration in Mathematics Education. No change in the program's name or the degree to be conferred is proposed.

B. *Brief description of the revision*

The revision addresses recommendations from the National Council of Teachers of Mathematics (NCTM) for accrediting the program with the National Council of Accreditation for Teacher Education. The revision also fully integrates UPRM's Secondary Education Teacher Preparation Program (Programa de Preparación de Maestros de Escuela Secundaria in Spanish, abbreviate PPMES) requirements so that Mathematics Education students can take advantage of the courses offered by that program as well as meet Puerto Rico Department of Education (PRDE) secondary mathematics teacher certification requirements.

C. *New requirements proposed*

- The proposed revision requires existing courses MATE 3181, Discrete Mathematics; MATE 4120, History of Mathematics; EDPE 3129, The Use of Microcomputers in the Classroom, and EDES 4006, Nature and Needs of Exceptional Learners.

The two mathematics courses broaden student preparation in mathematics in areas of growing importance in teaching secondary mathematics. Both were specifically recommended in NCTM's NATIONAL RECOGNITION REPORT on the existing Mathematics Education program. The two education courses respond directly to PRDE teacher certification requirements (the current requirements for certification as a secondary mathematics teacher in Puerto Rico may be found on the Department of Education website at

http://de.gobierno.pr/sites/de.gobierno.pr/files/ReglamentoCertificaciones_1.pdf).

A recent revision of UPRM's PPMES established three transition points that teacher candidates must pass to actually enroll in a student teaching course. The courses EDPE 3129, The Use of Microcomputers in the Classroom, and EDES

4006, Nature and Needs of Exceptional Learners, are part of the requirements delineated in these transition points.

- The proposed revision also requires one new two credit course MATE 4024, Teaching Mathematics using Technology.

This course has been developed to address the NCTM standard for preparation of mathematics teachers regarding the use of mathematics specific technology such as graphing calculators, symbolic computation programs, and geometry software in teaching mathematics.

D. Requirements under the existing program changed in the proposed revision

- The existing program course requirement in statistics, ESMA 4001, Mathematical Statistics I, will be replaced by the statistics course ESMA 3016, Statistical Data Analysis. The latter course more closely matches the NCTM statistics standard for secondary mathematics teacher preparation. It also aligns better with the statistics preparation that secondary mathematics teachers need to teach the statistics and probability courses offered in Puerto Rico high schools.

E. Requirements under the existing program eliminated or reduced in the proposed revision

The current four year program requires a total of 139 credits. In order to add the accreditation critical courses listed above and keep the program within a four year time frame, some of the existing program course requirements were eliminated.

- MATE 4009, Ordinary Differential Equations and MATE 4050, Undergraduate Seminar are required in the current program, but will not be required in the proposed revision.

Students who enroll in the proposed revision, especially those who indicate an interest in pursuing graduate studies, will be encouraged to take Differential Equations as well as Advanced Calculus, Elements of Topology, and an Introduction to Complex Variables with Applications. The required courses, Mathematics Teaching and Learning Resources, Teaching Mathematics using Technology, and the History of Mathematics; will provide a variety of opportunities for students in the proposed revision to develop the library search, professional reading, and presentation skills addressed by the Undergraduate Seminar in the current program.

- The science requirements will be reduced from 18 credits to 8 credits. Whereas the existing program requires 18 credits in general physics and general chemistry, the proposed revision requires 8 credit hours in selected introductory physics, chemistry, and geology courses.

The total number of required credits (139) in the proposed revision remains the same as the current program.

F. Duration of the program and maximum time allowed to complete the degree

As in the current program, a full-time student may complete the proposed revision in four years. The maximum time permitted to complete the degree will be eight (8) years as stipulated by the regulations governing undergraduate studies at the UPR Mayaguez Campus (Academic Senate Certification 05-32).

G. Probable implementation date

The Department of Mathematical Sciences is prepared to implement the proposed revision, as soon as it is approved by the corresponding academic and administrative University of Puerto Rico bodies and offices. No new facilities or faculty are needed to implement the proposed revision.

II. PROFESSIONAL ACREDITATION

The National Council for Accreditation of Teacher Education (NCATE) Board of Examiners visited UPRM in April, 2010 and recommended that the professional education unit be accredited. In October, 2010 the NCATE Unit Accreditation Board informed UPRM that accreditation without qualifications had been granted to its professional education unit (see copy of letter and accreditation report in Appendices). As part of its accreditation process, NCATE requires all teacher preparation programs within the unit to obtain national recognition from the corresponding specialized professional association. In the case of mathematics, that specialized professional organization is the National Council of Teachers of Mathematics (NCTM). The mathematics component of UPRM's Teaching Preparation Program in Secondary Education (PPMES) has been nationally recognized with conditions until February 1, 2011 by the NCATE. (A copy of the NCTM response is included in the appendices). The proposed revision of the Mathematics Education program responds directly to the recommendations from NCTM to meet requirements for full recognition. The proposed revision of the Mathematics Education program is a key part of the effort to achieve and maintain full NCATE accreditation.

III. JUSTIFICATION

A. *Academic reasons for the revision of the Math Ed option*

The UPRM Mathematics Education program has served the Puerto Rican community well. With a 94% (33 of 35) passing rate on the Mathematics Specialization Teacher Certification test over the three testing years 2007, 2008, and 2009; UPRM candidates for Puerto Rico secondary mathematics teacher certification have clearly been prepared to meet the content knowledge requirements of the Puerto Rico Department of Education. At the time of preparation of this proposal College Boards had not released data for tests administered in spring 2010, however one of UPRM's Mathematics Education students was notified that she earned the highest score on the PCMAS specialization exam. Given that UPRM has consistently obtained the highest scores, as a unit, on the PCMAS mathematics specialization exam, the mathematics preparation of UPRM secondary mathematics teachers is one of relative excellence. The proposed revision is intended and fully expected to improve both the mathematics preparation and the pedagogical preparation of program graduates.

The NCTM National Recognition Report on the Mathematics Education program at UPRM specifically recommended adding courses that introduce students to discrete mathematics and that address the historical developments of various strands of mathematics. NCATE utilizes the expertise of specialized professional associations like NCTM as part of the accreditation process. The NCTM report also calls for strengthening the role of mathematics specific technology in mathematics content courses, in pedagogical methods courses, and during the field experiences. The proposed revision of the Mathematics Education program adds required courses in Discrete Mathematics and the History of Mathematics.

UPR Board of Regents Certification 04-47, item D, calls for all teacher preparation programs in the UPR system to include all the courses necessary to fulfill requirements for teacher certification. Whereas the current program encourages students to take EDPE 3129, the Use of Microcomputers in the Classroom, and EDES 4006, Nature and Needs of Exceptional Learners as electives in order to meet PRDE requirements for teacher certification; the proposed revision requires these and all other courses needed for certification as secondary mathematics teachers. Under the present regulations, all first time candidates for certification as secondary school mathematics teachers in Puerto Rico must:

1. have a minimum of a bachelor's degree from an accredited higher learning institution or College.
2. have a GPA of no less than 2.50 overall and in the area of specialization

3. take and approve the PCMAS Basic Battery Test
4. show evidence that they have approved
 - a. a course on the nature of the exceptional child, which includes the topics of inclusion and technological assistance
 - b. a course on the integration of technology to education
 - c. a course on the History of Puerto Rico
 - d. a course on the History of the United States
 - e. approve a course on methodology in the teaching of mathematics
 - f. approve a teaching practice course with a minimum of 300 hours classroom contact

IV. RELATIONSHIP OF THE PROGRAM WITH THE MISSION AND THE STRATEGIC PLAN OF THE UNIVERSITY OF PUERTO RICO

A. Relation of the program with the institutional mission

UPRM's mission is to:

- Develop educated and cultured citizens, able to think critically and professionally, competent in the fields of agricultural sciences, engineering, sciences, arts and business administration, who can contribute to the cultural, social, technological and economic development of Puerto Rico and collaborate internationally in an environment of solidarity and democracy.
- Perform research and creative activities to serve the local, regional and international needs of society.
- Provide an exemplary service to the local, regional and international community to contribute to a sustainable and balanced development of our society and disseminate knowledge making it available to all those concerned.

Teachers can only teach what they know well. Lack of adequate preparation in mathematics is a widely documented problem that adversely affects teachers and students in Puerto Rico and the United States. To fully achieve its mission, UPRM must play a role in teacher preparation. To address this need, the faculty Department of Mathematical Sciences at UPRM established a mathematics education program in the 1980's to prepare more effective mathematics teachers. UPRM's teacher preparation model integrates that preparation into content departments. At UPRM, future mathematics teachers pursue a bachelor's degree in mathematics in the Department of Mathematical Sciences while they develop their pedagogical knowledge base in the Secondary Education Teacher Preparation Program (PPMES). This parallel structure supports the development of breadth and depth of content knowledge needed to complement the pedagogical and

knowledge skills to be effective in the classroom. This approach recognizes that teaching mathematics requires pedagogical knowledge particular to mathematics; such as using and connecting multiple representations, developing precise notation and vocabulary, using mathematics specific technologies, and eliciting clear reasoning; the proposed program expands the requirements in education courses specific to mathematics. In congruence with the institution's mission, rather than produce teachers that know mathematics, the original program was designed to prepare mathematicians that know how to teach mathematics. This continues to be an essential tenet of the proposed revision.

B. Relationship of the program to the institutional strategic plan

The proposed revision responds directly to four of the institutional objectives mentioned in the system wide strategic plan *Diez para la Decada*. Loosely stated these are:

- to obtain and maintain professional accreditation of all programs which are subject to such processes;
- to strengthen the relationship between UPR and the K-12 Puerto Rico education system;
- to foster the continuous and systematic revision of academic offerings; and
- to encourage research in disciplines with strong potential to attract competitive external funding

Members of the Department of Mathematical Sciences have contributed to the school mathematics curricula in Puerto Rico, developed pre-college mathematics materials, provided professional development for mathematics teachers, and worked with mathematically talented pre-college students for over 30 years. See the faculty profile for further details about the nature and extent of the collaboration between the Department of Mathematical Sciences and Puerto Rico K-12 mathematics.

C. Relationship of the Program to the Campus Strategic Plan

UPRM's strategic plan was revised in 2007. This revision identifies updating Campus academic offerings as critical. *Achieve and maintain professional accreditation standards in all UPRM Programs* is an explicitly stated strategic orientation with regard to curriculum, learning, and teaching. The plan calls for an increase in the number of professional offerings, paying special attention to those that address societal needs. The plan calls for the development of knowledge and serving the community. The plan also calls for the broadening of educational program offerings for pre-college level students.

The proposed mathematics education revision addresses specific concerns raised in the NCTM/NCATE accreditation report. It also addresses PRDE requirements for certification of secondary mathematics teachers that are not met in the existing program. The effort to maintain a nationally accredited program to produce well prepared mathematics teachers responds to a critical need of Puerto Rico's pre-college educational system. The proposed revision is well aligned with and responds to the campus strategic plan within the University of Puerto Rico's social context and economic reality.

D. Relationship of the Program to current academic offerings in or outside UPR

The current program was designed to graduate mathematics specialists prepared to be effective mathematics teachers. In the current program, the Department of Mathematical Sciences designs and offers the mathematics (content) courses; while UPRM's Secondary Education Teacher Preparation (PPMES) designs and offers the pedagogy courses including the education foundations, special education, and education technology courses. The PPMES coordinates and manages the methodology and teaching practice courses: placing candidates in schools; selecting and evaluating cooperating teachers, and recruiting university supervisors for student teachers. The university teaching practice supervisors are recruited from the Department of Mathematical Sciences faculty. Both the Department of Mathematical Sciences and the PPMES advise students enrolled in the program regarding their progress towards meeting teacher certification requirements. Thus, over recent years, the supervision and counseling of mathematics student teachers has become a collaborative effort by the Department of Mathematical Sciences and the PPMES. This collaboration has proven effective, providing the future mathematics teacher with content expert support in the classroom and UPRM mathematics faculty with insight into the particular mathematics needs of Puerto Rico's secondary mathematics teachers. It is the express intent of the proposed revision to maintain this collaboration in which the Department of Mathematical Sciences is a robust contributor to the preparation of secondary mathematics teachers.

The UPRM mathematics teacher preparation program is a model in which mathematicians prepare professional mathematics educators as mathematicians first. No other mathematics teacher preparation program in Puerto Rico works from this premise. The core mathematics curriculum of the proposed revision of the Mathematics Education program remains one of the most demanding among higher learning institutions on the island. For the proponents, this characteristic is an essential strength of the program.

The PPMES has established specific requirements for students to enroll in Student Teaching courses. The specific requirements for enrollment in the Student Teaching of Mathematics in Secondary School course were established by the PPMES in consultation

with the Department of Mathematical Sciences. These requirements were motivated by an analysis of the performance of UPRM candidates on Puerto Rico's teacher certification tests (PCMAS) and by the effort to thoroughly prepare teaching candidates before placing them in a teaching situation. The Department of Mathematical Sciences Faculty recognizes the value of the student teaching experience both for the theoretical and professional development of its Mathematics Education graduates. Therefore, the proposed revision includes the student teaching course and all of its prerequisites in the revised curriculum.

Whereas students in the existing Mathematics Education program must use their free electives to be able to exercise the option to seek certification as secondary mathematics teachers, the revised program integrates all the courses students need to apply for certification. The revised program allows students to follow a transparent, straight forward curricular path toward certification in accordance with section D part II of UPR Board of Trustees Certification 47, 2004-2005.

V. CONCEPTUAL FRAMEWORK FOR THE PROGRAM

UPRM's conceptual framework for Teacher Preparation seeks to develop ten proficiencies in its future teachers:

- Possess strong content knowledge
- Possess pedagogical content knowledge
- Possess knowledge of human development and learning
- Exhibit comprehensive formation , communication and leadership skills
- Assess student learning effectively
- Demonstrate caring disposition
- Demonstrate sensitivity to diversity
- Demonstrate community building skills
- Demonstrate reflective practice
- Demonstrate critical thinking skills

The proposed revision for Mathematics Education meets each of these as follows:

Possess content knowledge: In the proposed revision candidates must complete 36 credits in mathematical sciences including calculus, discrete mathematics, linear algebra,

abstract algebra, foundations, geometry, number theory, mathematics history, statistics, and computer programming.

Possess pedagogical content knowledge: In their methodology and mathematics education courses, candidates study a repertoire of pedagogical techniques that educational research has demonstrated to be effective for teaching mathematics. During their student teaching, candidates use a variety of techniques to help students make sense of mathematics under the guidance of an experienced teacher mentor and a mathematics professor.

Possess knowledge of human development and learning: Candidates must complete 6 credits in human development and learning. During their student teaching, candidates are evaluated on application of their knowledge of how students learn, how they help students progress from basic to more abstract mathematics, and how they provide the scaffolding that supports this process.

Exhibit comprehensive formation-communication leadership skills: The methodology and mathematics education courses prepare candidates to use effective verbal and nonverbal communication skills to help students learn mathematics. Traditional mathematics courses require candidates to write, speak, and think in precise mathematical terms. Under the current program, candidates are required to apply classroom technology and mathematics specific technology in class demonstrations in the *Use of Microcomputers in the Classroom* course. Under the proposed revision, candidates will be required to make additional class demonstrations in the *Teaching Mathematics with Technology* course using a variety of mathematics specific technology tools. During their student teaching candidates are evaluated on how effectively they communicate with students, how they utilize technology to support the learning of mathematics, and how they contribute to the comprehensive formation of students.

Assessment of student learning: Candidates learn a variety of assessment techniques during their methodology and mathematics education courses. Candidate use of the assessment process is closely monitored and evaluated by the university supervisor and the cooperating teacher throughout the student teaching experience. Candidate use of assessment to measure student learning and to plan subsequent instruction according to the results is a key aspect of the Teacher Candidate Work Sample required during student teaching.

Demonstrate caring disposition: During their student teaching, candidates are evaluated on their ability to create an atmosphere of trust conducive to learning and on their disposition to help all students learn. Candidates discuss learning problems encountered during their student teaching in weekly meetings with university supervisors. These

discussions often include several mathematics candidates. As teacher/observers, candidates have a unique opportunity to interact with students.

Demonstrate sensitivity to diversity: During the *Nature and Needs of Exceptional Learners* course, candidates are required to observe 15 hours of special education classroom situations and plan lessons that take the special needs observed into account. Candidates must document their sensitivity and tolerance to the diverse needs and performance levels of learners within gender and cultural differences with activity modifications to lesson plans as part of their Teacher Candidate Work Sample.

Demonstrate community-building skills: During student teaching, candidates are evaluated with respect to their ability to establish a community of trust in the classroom. They are also evaluated with respect to the professional relationships they form with teachers, administrators, parents, and the community.

Demonstrate reflective practice: During student teaching, candidates are evaluated with respect to their willingness to implement suggestions for improving classroom effectiveness and on their participation in numerous professional development activities offered by the PPMES. They are also required to prepare an electronic portfolio that demonstrates reflective thinking. This requirement serves to develop the habit of reflecting on teaching effectiveness in terms of student learning and to prepare candidates to take charge of and direct their future development as teaching professionals.

Demonstrate creative critical thinking: The critical thinking in mathematical problem solving, formal demonstrations, and precise mathematical explanations are explicit objectives in *Foundations of Mathematics*, *Abstract Algebra*, *Discrete Mathematics*, *Number Theory*, and *Geometry*. These, like most mathematics courses, require candidates to practice the critical thinking that is the essence of mathematics. During student teaching, candidates are evaluated on their application of critical thinking in the context of teaching mathematics in the classroom.

A. *Mission of the program*

The mission of the Mathematics Education option of the undergraduate mathematics program at UPRM is to serve Puerto Rico's need for highly qualified mathematics teachers. The revision will enhance the program's capacity to fulfill this mission.

B. Goals of the program

The goal of the Mathematics Education option of the undergraduate Mathematics program continues to be to produce mathematicians who are prepared to be effective secondary mathematics teachers.

C. Objectives of the program

All the objectives of the current Mathematics Education program remain an important part of the revised program (see subsequent chart for a side by side listing of the objectives of the current program and the objectives of the proposed revision). Additional objectives in mathematics content knowledge; professional and pedagogical knowledge; and professional skills and dispositions have been added in the proposed revision both to clarify expectations for mathematics teacher candidates and to address NCTM/NCATE recommendations.

Below are the added objectives from the revised Mathematics Education program. Program graduates will also be expected to demonstrate:

- ME 5 Ability to apply the fundamental ideas of discrete mathematics in the formulation and solution of problems.
- ME 6 Ability to apply the concepts and practices of data analysis, statistics, and probability to design experiments; collect, analyze, and interpret data.
- ME 7 Basic knowledge of the historical development of the key strands of mathematics such as number systems, algebra, geometry, calculus, discrete mathematics, and statistics including the past and present contributions from diverse cultures to these developments.
- ME 8 Basic pedagogical knowledge and methodology for classroom mathematics instruction.
- ME 9 Knowledge of both classroom technology and mathematics specific technology including how to use these to facilitate and enhance learning mathematics.
- ME 10 Classroom communication skills to demonstrate the utility of mathematics to formulate and solve problems in the appropriate abstract setting as well as to convey the power of mathematical reasoning beyond its utility and precision.
- ME 11 Pedagogical skills to create and deliver learning experiences that help all students learn.
- ME 12 Skills in the assessment of student mathematical learning for formative and evaluative purposes.
- ME 13 Skills in creating and maintaining a classroom community characterized by a mutual respect that is conducive to inquiry and learning.
- ME 14 Professional and ethical behavior while teaching and carrying out other

- duties particularly with respect to fairness and equity.
- ME 15 Concern for student well-being as well as for learning mathematics.
 - ME 16 Sensitivity to the diversity in culture, religion, interests, and all its manifestations among students especially those that affect learning.
 - ME 17 Reflective habit and commitment to personal professional development focused on improving student learning.
 - ME 18 The constructive disposition to work with students, colleagues, parents, and the community to address and resolve issues that affect student learning both in mathematics and in their general formation.

The following tables compare the objectives of the current and Mathematics Education program and the proposed revision.

Content Knowledge	
With respect to Mathematics Knowledge, Graduates of the Current Mathematics Education program are expected to demonstrate:	With respect to Mathematics Knowledge, Graduates of the Proposed Mathematics Education program will be expected to demonstrate:
EM ¹ 1 Basic knowledge of mathematical analysis	ME ² 1 Basic knowledge of computer programming and mathematical analysis
EM 2 Basic knowledge of the foundations of mathematics(including logic, set theory among others) and algebra, enabling them to develop and write mathematical proofs.	ME 2 Basic knowledge of the foundations of mathematics(including logic, set theory among others) and algebra, enabling them to develop and write mathematical proofs.
EM 3 Basic knowledge of linear and abstract algebra.	ME 3 Basic knowledge of linear and abstract algebra.
EM 4 Basic knowledge of geometry and number theory.	ME 4 Basic knowledge of geometry and number theory.
	ME 5 Ability to apply the fundamental ideas of discrete mathematics in the formulation and solution of problems.
	ME 6 Ability to apply the concepts and practices of data analysis, statistics, and probability to design experiments; collect, analyze, and interpret data.
	ME 7 Basic knowledge of the historical development of the key strands of mathematics such as number systems, algebra, geometry, calculus, discrete mathematics, and statistics including the past and present contributions from diverse cultures to these developments.

¹ EM = Mathematics Education Current Program

² ME = Mathematics Education Proposed Program

Professional and Pedagogical Knowledge	
With respect to Professional and Pedagogical Knowledge, Graduates of the Current Mathematics Education program are expected to demonstrate:	With respect to Professional and Pedagogical Knowledge, Graduates of the Proposed Mathematics Education program will be expected to demonstrate:
	ME 8 Basic pedagogical knowledge and methodology for classroom mathematics instruction
	ME 9 Knowledge of both classroom technology and mathematics specific technology including how to use these to facilitate and enhance learning mathematics.
EM 10 The ability to apply mathematics to formulate and solve mathematics problems and present their work clearly.	ME 10 Classroom communication skills to demonstrate the utility of mathematics to formulate and solve problems in the appropriate abstract setting as well as to convey the power of mathematical reasoning beyond its utility and precision.
EM 12 The ability to provide effective learning experiences for secondary school students.	ME 11 Pedagogical skills to create and deliver learning experiences that help all students learn.
	ME 12 Skills in the assessment of student mathematical learning for formative and evaluative purposes
EM 8 Ability to control groups of students.	ME 13 Skills in creating and maintaining a classroom community characterized by a mutual respect that is conducive to inquiry and learning.

Professional Skills and Disposition	
With respect to Professional Disposition, Graduates of the Current Mathematics Education program are expected to demonstrate:	With respect to Professional Disposition, Graduates of the Proposed Mathematics Education program will be expected to demonstrate:
EM 7 Adherence to ethical standards in their studies and in their professional endeavors.	ME 14 Professional and ethical behavior while teaching and carrying out other duties particularly with respect to fairness and equity.
	ME 15 Concern for student well-being as well as for learning mathematics.
EM 14 A solid formation in general education courses.	ME 16 Sensitivity to the diversity in culture, religion, interests, and all its manifestations among students especially those that affect learning.

Professional Skills and Disposition	
EM 13 A solid base and an integral education that allows them to perform as mathematics teachers in either middle school or high school or to continue graduate studies.	ME 17 Reflective habit and commitment to personal professional development focused on improving student learning
EM 6 Ability to interact adequately in a school environment. EM 9 Ability to work in a group with other teachers. EM 11 Ability to work in a group with people from other professional areas during the process of solving a problem. In addition, the self-confidence to take the initiative, make decisions and to contribute new ideas.	ME 18 The constructive disposition to work with students, colleagues, parents, and the community to address and resolve issues that affect student learning both in mathematics and in their general formation

D. Profile of graduates from the program

Graduates of the revised Mathematics Education program will:

- P 1 know, understand, and apply the process of mathematical **problem solving**. They will be able to apply and adapt a variety of appropriate strategies to solve problems that arise in mathematics and in other contexts that involve mathematics. They will be able to help students build mathematical knowledge through problem solving and reflection on the process of mathematical problem solving.
- P 2 be able to reason, construct, and evaluate mathematical arguments demonstrating an appreciation for mathematical rigor and inquiry. They will be able to convey that **reasoning and proof** are fundamental aspects of mathematics to students making and investigating mathematical conjectures.
- P 3 **communicate** their mathematical thinking coherently and clearly to peers, faculty, and others using correct mathematical vocabulary and notation. They will be able to analyze and evaluate the mathematical thinking of students and guide them to communicate that thinking in precise mathematical terms.
- P 4 recognize, use, and make **connections** between and among mathematical ideas and in contexts outside mathematics to build mathematical understanding. They will be able to demonstrate how mathematical ideas interconnect and build on one another.

- P 5 use multiple **representations** to model and interpret the mathematics in physical, social, and other situations in a way that develops student mathematical understanding. They will be able to choose between verbal, numerical, algebraic, graphical, and other representations and translate from one representation to another in order to solve problems.
- P 6 use **technologies** such as spreadsheets, graphing tools, computer algebra systems, statistical packages, data-collection devices, and presentation software to teach and learn mathematics.
- P 7 support **learning mathematics with understanding** for all students through attention to equity, knowledge and use of challenging curricula, and knowledge and use of formative assessment.
- P 8 reflect on student learning in order to increase effectiveness in the classroom sharing teaching insights gleaned from this process as well as other aspects of **professional development** with colleagues.
- P 9 demonstrate passion for the beauty and effectiveness of mathematics. Such **passion for mathematics** is essential to prepare good students and inspire them to pursue careers in mathematics, science, and technology.

E. Teaching Philosophy

Teachers can only teach what they know well. Lack of adequate preparation in mathematics is a widely documented problem that adversely affects teachers and students in Puerto Rico and the United States. The faculty of the UPRM Department of Mathematical Sciences established the mathematics education option in the 1980's to prepare more effective mathematics teachers to address this problem.

Despite the emphasis on learning the mathematics, a core tenet of the proposed revision's philosophy is that the mathematical knowledge required for teaching mathematics is different from the mathematical knowledge required to use mathematics in engineering, science, technology or in other professions. The ability to apply mathematics is necessary, but not sufficient to teach mathematics. Mathematics teachers must master basic concepts in a way that enables them to help others make sense of those concepts and the related procedures. They must become adept at using multiple representations to facilitate mathematical understanding, know how to connect mathematics to its applications and to other areas of knowledge, and be able to probe and provoke student

depth of understanding. In addition, mathematics teachers must be able to present the same concept in more than one format and support learners in the process of developing alternate explanations. Mathematics teachers need to be able to explain clearly, set up good problems, connect them to alternate models, prepare didactic materials, and detect and correct incomplete understanding.

VI. CURRICULAR DESIGN

A. *Mathematics Courses in the Curriculum*

COMP 3010. INTRODUCTION TO COMPUTERS I. Three credit hours. Two hours of lecture and one two hour laboratory per week. Prerequisite: MATE 3171 or MATE 3005 or MATE 3143. (Core)

Fundamental concepts of procedural programming. Topics include data types, control structures, functions, arrays, files, and the experience of running, testing, and debugging programs.

MATE 3020. INTRODUCTION TO THE FOUNDATIONS OF MATHEMATICS. Three credit hours. Three hours of lectures per week. Prerequisite: MATE 3031 or MATE 3183 or MATE 3144 or authorization of the Director of the Department. (Core)

An introductory course in set theory and logic. Topics include the propositional calculus and set algebra, finite and infinite sets, well-ordered sets, transfinite arithmetic, Peano's axioms, and development of the real number system.

MATE 3030. INTRODUCTION TO GEOMETRY. Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3032 or MATE 3184. (Mathematics Education)

Brief review of Euclidean geometry, geometric constructions, similarity of figures, geometry of the triangle and of the circle, foundations of axiomatic geometry, and elements of non-Euclidean geometry.

MATE 3031. CALCULUS I. Four credit hours. Four hours of lecture per week. Prerequisite: MATE 3005 or 3143 or MATE 3172 or MATE 3174. (Core)

Elementary differential and integral calculus of one real variable with applications.

MATE 3032. CALCULUS II. Four credit hours. Four hours of lecture per week. Prerequisite: MATE 3031. (Core)

Integration techniques, infinite series, vectors, polar coordinates, vector functions, and quadric surfaces.

MATE 3040. THEORY OF NUMBERS. Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3032 or MATE 3184. (Mathematics Education)

Divisibility, number systems, Euclid's algorithm, factorization, the distribution of primes, perfect numbers and related topics, Euler's function, indeterminate problems, diophantine problems, and congruences.

MATE 3063. CALCULUS III. Three credit hours. Three hours of lecture per week. Pre-requisite: MATE 3032 or MATE 3184. (Core)

Differential and integral calculus of several variables with applications, and an introduction to differential equations with applications.

MATE 3181. DISCRETE MATHEMATICS I. Three credit hours. Three hours of lecture per week. Prerequisites : MATE 3031. (Mathematics Education)

Sets, relations and notation; algorithms; logic; graphs; trees.

MATE 4008. INTRODUCTION TO ALGEBRAIC STRUCTURES. Three credit hours. Three lectures per week. Prerequisite: MATE 3020. (Core)

Introduction to algebraic systems; sets, semigroups, groups, rings, fields.

MATE 4023. MATHEMATICS TEACHING AND LEARNING RESOURCES. Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3020.

Resources for mathematics learning activities. Selecting, adapting, and analyzing classroom activities in terms of student learning. Developing effective activities for teaching mathematics at the intermediate and secondary levels.

MATE 4024. THE TEACHING OF MATHEMATICS USING TECHNOLOGY. Two credit hours. Two hours of lecture per week. Prerequisite: EDPE 3129 y MATE 4023.

Use and impact of technology in secondary mathematics curriculum. Various technologies including graphing calculators, spreadsheets, dynamic geometry software and the Internet will be used to explore secondary school mathematical concepts from the teaching and learning viewpoint.

MATE 4031. INTRODUCTION TO LINEAR ALGEBRA. Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3032. (Core)

Euclidean vector spaces, matrices and linear equations, spectral decomposition of normal operators.

MATE 4120. HISTORY OF MATHEMATICS. Three credit hours. Three hours of lecture per week. Prerequisite: MATE 3032. (Mathematics Education)

A survey of the historical development of the elementary branches of Mathematics.

ESMA 3016. STATISTICAL DATA ANALYSIS. Three credit hours. Two hours of lecture and one two-hour laboratory per week. Pre-requisite: (MATE 3031 or MATE 3144) and COMP 3010. (Core)

Statistical data analysis including descriptive and inferential statistics and exploratory data analysis.

B. Pedagogical Courses in the Curriculum

EDFU 3001-3002. HUMAN GROWTH AND DEVELOPMENT I AND II. Six credits. Three hours of lecture per week each semester.

The first semester will be devoted to an inquiry on the nature of psychology as background for a better understanding of the educational process. The growth and development of children and adolescents will be examined as well as the natural and environmental forces which influence the development of a well balanced personality.

The second semester, the student will analyze the psychological principles which underlie the teaching-learning process and the individual and social conditions which act upon it. Analysis of the process of evaluation and the principles underlying the creation of educational testing and grading.

EDFU 3007. SOCIAL FOUNDATIONS OF EDUCATION. Three credits. Three hours of lecture per week.

Analysis of the basic social science principles in terms of the educational process. Study and discussion of the social problems that have conditioned the development of education in Puerto Rico.

EDFU 4019. PHILOSOPHICAL FOUNDATIONS OF EDUCATION. Three credits. Three hours of lecture per week.

Study of philosophic theory and its relation to pedagogical practice. Presentation of major problems that have been caused by conflicting educational philosophies in terms of their historical development and their present day impact. The course emphasizes and clarifies the role of the teacher in regard to educational goals, curriculum programs, and evaluation. Basic philosophical problems such as the meaning of truth and knowledge; the relation between knowledge and action; the nature of beauty, truth, happiness; and their educational implications are analyzed. The course also endeavors to promote an understanding of the way in which the development of the scientific method, the progress of democracy, changes in social and economic institutions, and the advance of human knowledge demand changes in philosophical attitudes as well as in all educational practice.

EDPE 3129. THE USE OF MICROCOMPUTERS IN THE CLASSROOM. Three credits. Three hours of lecture per week.

Introductory courses on the role of microcomputers in the classroom. Special emphasis will be given to the use of Microcomputers in the school setting, resources that are available to the classroom teacher and how to integrate computers to teaching. Workshop experiences and special assignments will complement class discussions.

EDES 4006. NATURE AND NEEDS OF EXCEPTIONAL LEARNERS. Three credits. Three hours of lecture per week.

This course offers a overview of the psychological and educational needs of exceptional learners. It provides the experiences and knowledge necessary for the design and implementation of curricular programs, special teaching techniques, and strategies appropriate for exceptional learners. Laboratory and field experiences will be an integrate part of the course.

EDPE 4145. THEORY METHODOLOGY TEACHING MATHEMATICS SECONDARY SCHOOL. Three credit hours. Three hours of lecture per week.

Theoretical and practical approach to the teaching-learning process. All aspects related to the teaching of Mathematics in Secondary School are Studied: Planning, Innovative Education and Curriculum Analysis; Basic Content in this area of Specialization, Preparation, Adaptation and Utilization of Resources; Methodology, Teaching Techniques and Strategies; Fundamentals of Measurement and Evaluation. These contents are integrated on a Practical Basis. All students must complete at least 15 hours of laboratory experiences in public or

private schools. These experiences will enable students to develop critical, dynamic and creative attitudes toward Puerto Rican Educational problems.

EDPE 4146. STUDENT TEACHING OF MATHEMATICS IN SECONDARY SCHOOL. Six credits. Twenty hours of practice per week.

The course requires that teacher candidates lead the process of learning and teaching in a public or private; that they participate in school activities and attend seminars offered at the University of Puerto Rico. Through these experiences teacher candidates are equipped with theories, practical techniques and methods to develop their knowledge, skills and attitudes that contribute to improvements in practicum. In addition, we discuss and analyze current topics in the field of study or situations that arise during their practicum. A University professor, a cooperating teacher and the school principal supervise the teacher candidate. The teacher candidate attends four hours daily to the school or the seminar at the University as scheduled in the semester calendar.

C. Model course schedule

The model course schedule for the current program and proposed programs are shown side by side on the following page.

Current Program Total credits: 139

FIRST YEAR			
COURSE	Crds	COURSE	Crds
MATE 3005	5	MATE 3031 *	4
QUIM 3131	3	QUIM 3132	3
QUIM 3133	1	QUIM 3134	1
CIBI 3031	3	CIBI 3032	3
ESPA 3101	3	ESPA 3102	3
INGL 3---	3	INGL 3---	3
		EDFI ----	1
Total credits	18	Total credits	18
SECOND YEAR			
COURSE	Crds	COURSE	Crds
MATE 3032 *	4	MATE 3030 *	3
MATE 3020 *	3	MATE 3063 *	3
COMP 3010*	3	MATE 4031 *	3
ESPA 3---	3	ESPA 3---	3
INGL 3---	3	INGL 3---	3
EDFI ----	1	EDFU 3007	3
Total credits	17	Total credits	18
THIRD YEAR			
COURSE	Crds	COURSE	Crds
MATE 4009 *	3	ESMA 4001 *	3
MATE 4008 *	3	MATE 3040 *	3
FISI 3171	4	FISI 3172	4
FISI 3173	1	FISI 3174	1
HIST 3241 or HIST 3242	3	HIST 3111 or HIST 3112	3
EDFU 3001	3	EDFU 3002	3
Total credits	17	Total credits	17
FOURTH YEAR			
COURSE	Crds	COURSE	Crds
MATE 4023 *	3	MATE 4050 *	1
EDFU 4019	3	EDPE 4146	6
EDPE 4145	3	HUMA 3112	3
HUMA 3111	3	Free Elective**	3
Free Elective **	3	Free Elective**	3
Free Elective **	3		
Total credits	18	Total credits	16

Proposed Program Total credits: 139

FIRST YEAR			
COURSE	Crds	COURSE	Crds
MATE 3005	5	MATE 3031 *	4
EDFU 3001	3	EDFU 3002	3
CIBI 3031	3	CIBI 3032	3
ESPA 3101	3	ESPA 3102	3
INGL 3101	3	INGL 3102	3
Total credits	17	Total credits	16
SECOND YEAR			
COURSE	Crds	COURSE	Crds
MATE 3032 *	4	MATE 3063 *	3
MATE 3020 *	3	MATE 3030 *	3
FISI, QUIM or GEOL	4	ESMA 3016 *	3
ESPA ----	3	FISI, QUIM or GEOL	4
INGL 3---	3	EDFU 3007	3
EDFI ----	1	EDFI ----	1
Total credits	18	Total credits	17
THIRD YEAR			
COURSE	Crds	COURSE	Crds
MATE 4031 *	3	MATE 4008 *	3
MATE 3040 *	3	MATE 3181 *	3
COMP 3010 *	3	EDFU 4019	3
ESPA 3---	3	EDPE 3129 *	3
HIST 3214 or HIST 3242	3	HIST 3111 or HIST 3112	3
INGL 3---	3	Free Elective	3
Total credits	18	Total credits	18
FOURTH YEAR			
COURSE	Crds	COURSE	Crds
EDPE 4145	3	EDPE 4146	6
MATE 4023 *	3	MATE 4024 *	2
MATE 4120 *	3	HUMA 3112	3
HUMA 3111	3	Free Elective	3
EDES 4006	3	Free Elective	3
Free Elective	3		
Total credits	18	Total credits	17

* Specialization Course (courses from which specialization GPA will be calculated)

D. Curricular Coherence

In alignment with the UPRM curricular framework for Teacher Preparation, the objective of the proposed Mathematics Education program revision is to produce teaching professionals with the following ten proficiencies:

- Possess strong mathematical content knowledge
- Possess pedagogical content knowledge
- Possess knowledge of human development and learning
- Exhibit comprehensive formation , communication and leadership skills
- Assess student learning effectively
- Demonstrate caring disposition
- Demonstrate sensitivity to diversity
- Demonstrate community building skills
- Demonstrate reflective practice
- Demonstrate critical thinking skills

The development of strong mathematical content knowledge is supported by 38 credits in mathematics beyond precalculus with 26 credits in core mathematics courses required for all mathematics majors at UPRM and 12 credits in mathematics content courses that meet specific National Council of Teachers of Mathematics content standards.

Core Mathematics Courses (26 Credits)

Code	Course Title	Credits	Prerequisite
MATE 3031	Calculus I	4	MATE 3172or MATE 3005
MATE 3032	Calculus II	4	MATE 3031
MATE 3063	Calculus III	3	MATE 3032
MATE 3020	Introduction to the Foundations of Mathematics	3	MATE 3031
COMP 3010	Introduction to Computer Programming I	3	MATE 3171 or MATE 3005
MATE 4031	Introduction to Linear Algebra	3	MATE 3032
MATE 4008	Introduction to Algebraic Structures	3	MATE 3020
ESMA 3016	Statistical Data Analysis	3	MATE 3031

Mathematics Education Option Mathematics Courses (12 Credits)

Code	Course Title	Credits	Prerequisite
MATE 3030	Introduction to Geometry	3	MATE 3032
MATE 3040	Theory of Numbers	3	MATE 3032
MATE 3181	Discrete Mathematics I	3	MATE 3031
MATE 4120	History of Mathematics	3	MATE 3032

Further details of the alignment between required courses and candidate proficiencies are shown in Appendix I.

In addition to coursework, candidate ability to use student learning assessment is evaluated in the six or more classroom observations and in the Teacher Candidate Work Sample during teaching practice. See the Mathematics Classroom Observation Form, the Teacher Candidate Work Sample Instruction Manual, and the Electronic Portfolio evaluation rubric for details.

The demonstration of caring disposition is addressed by a specific section of the classroom observation form. The demonstration of sensitivity to diversity is a key part of the field experience in EDES 4006, Nature and Needs of the Exceptional Child. This aspect of candidate disposition is also evaluated in the six or more classroom visits and the Teacher Candidate Work Sample during teaching practice.

The demonstration of community building skills, reflective practice, and critical thinking skills are each addressed by specific sections of the classroom observation form used in the teaching practice course. The community building skills are critical to creating and sustaining a secure classroom environment that supports learning. The demonstration of reflective practice, the habit of reviewing the effectiveness of classroom activities in terms of measured student learning, was an important motivation for UPRM adoption of a Teacher Candidate Work Sample requirement. The development of the critical thinking skills for instruction decisions is addressed by a section of the classroom observation form. The development of critical thinking skills is one of the underlying themes expected from all required undergraduate courses in the College of Arts & Sciences at UPRM.

Candidate comprehensive formation and the development of communication, and leadership skills are addressed by the broad array of undergraduate courses (69 credits) required by the College of Arts & Sciences at UPRM and shown in the table above.

Within these courses, communication skills are supported by 12 credits in English and 12 credits in Spanish. UPRM requires all teacher preparation students to take a Writing Skills and Dispositions test early in their career. Students who perform poorly on the test are advised to take additional courses in composition, to work with the campus Writing Center, and/or to consult with their academic counselors to consider other programs.

There is also internal coherence between the curriculum and the stated learning objectives of the program. Each required content and pedagogy course responds to one or more learning objective and each learning objective is supported by one or more required courses. See table in the Appendix II matching the program learning objectives to required mathematics and pedagogy courses.

E. Instructional Methodologies

Both the current and revised curriculum allow for the use of multiple instructional methodologies and strategies such as the traditional lecture, integration of technology in learning, student to student learning, activation of prior learning, conceptual maps, discussions, cooperative learning exercises, group work, classroom presentations and demonstrations, among others.

F. Learning Outcomes Assessment Plan

The content knowledge learning objectives of the program are assessed by tracking the candidates' grades in both the Mathematics and Mathematics Education Core Courses. The three undergraduate programs in the Department of Mathematical Sciences, namely Computer Science, Mathematics Education, and Pure Mathematics require a grade of "C" or better in every Mathematical Sciences course. An additional assessment instrument for the content knowledge objectives for mathematics education students is the PCMAS Mathematics Specialization Test.

The program will continue to use the same instruments as the PPMES to assess how well candidates meet the pedagogical knowledge and the professional disposition learning objectives. These instruments are the Writing and Dispositions Essay, the Teacher Candidate Work Sample (TCWS) assessment, the Unit Planning assessment, the Student Teaching classroom observation form, and the results of the PCMAS Basic Battery Test. The Writing and Dispositions Essay is administered during the first semester of the teacher candidate's second year. The essay is used to assess the candidate's command of written Spanish and disposition to be a teacher. The results of the Writing and Dispositions Essay are used to counsel and advise candidates. Candidates whose essays

are rated not satisfactory are advised to take additional communications courses and to use the tutoring services offered by the Editing and Writing Center in the Department of Hispanic Studies. Candidates whose dispositions and attitudes are judged inadequate for the teaching profession are provided information and recommendations regarding other academic programs and careers.

The Teacher Candidate Work Sample guides candidates through a thorough documentation of their passage through the key steps in the thinking/learning process, deepening their student experience and enabling them to become self-directed teaching professionals. The Unit planning assessment is embedded in the TCWS. In the TCWS Contextual Factors section, the candidate documents use of information about the learning teaching context and student differences to set learning goals and plan instruction and assessment. In on the Learning Goals section, the teacher candidate documents setting significant, challenging, varied, and appropriate learning goals. In the Instructional Design section, the candidate documents instruction design for specific learning goals and student characteristics and needs within the learning context of a classroom. Finally the Unit Planning assessment includes an Instructional Decision-Making section in which the candidate documents regular and systematic evaluations of student learning and reasoning for subsequent instructional decisions.

The TCWS includes an Assessment Plan in which the teacher candidate documents the use of multiple assessment modes and approaches in line with the learning goals to assess student learning before, during and after instruction. It also includes an Analysis of Student Learning section in which the candidate collects, documents, and uses assessment data to profile student learning and communicate information about student progress and achievement. . Finally the TCWS includes a Self Evaluation Reflection section in which the candidate reflects on his or her instruction and student learning in order to improve teaching practice.

An extensive student teaching classroom observation protocol addresses candidate performance aligned with the UPRM conceptual framework for teacher preparation. Special items in the protocol were added by mathematics candidate supervisors to address specific mathematics learning concerns such as mathematical connections, use of precise vocabulary, correct symbol usage, and multiple forms of representation.

G. Course Syllabus (see appendices)

VII. ADMISSION, REGISTRATION AND GRADUATION

The Minimal Index for Admission (IGS) for the revised Mathematics Education program will be the same as the index for the Pure Mathematics and Computer Science programs offered by the Department of Mathematical Sciences. No significant change in the enrollment projection for the program is expected. The total number of credits in the program remains unchanged (139 credits). Graduation requirements regarding transfers, repetition of courses, residence and minimum GPA are governed by the current UPRM policy stated on page 73 of the Undergraduate Catalogue to comply with current standards for teacher certification in Puerto Rico, a minimum general GPA and major GPA of 2.5 will be required to all Math Education program graduates.

VIII. Faculty Profile

Name	Specialty Area	Institution	Rank	Type of Position	Degree-Year	Years of Experience	Courses to teach	Expected Academic Load in credits	Expected Number of Preparations
Edgar Acuña	Linear Models, Data Analysis and Computational Statistics	University of Rochester	Professor	Permanent	1989	18		6	2
Carmen Bellido	Education	University of Puerto Rico	Associate Professor	Permanent	1997	11		12	3
Luis Cáceres	Logic, Algebra, technology and Mathematics Education	University of Iowa	Professor	Permanent	1998	15		6	2
Wieslaw Dziobiak	Algebra and Logic	Wroclaw University	Professor	Permanent	1982	25		12	3
Edgardo Lorenzo	Applied Statistics and applications to Mathematics Education	Wichita State University	Associate Professor	Permanent	2002	6		12	3
Rafael Martínez	Geometry Topology and Mathematics Education	Michigan State University	Professor	Permanent	1983	24		12	2
Daniel McGee	Mathematical Modeling, technology and Mathematics Education	University of Arizona	Professor	Permanent	1995	12		6	1

Name	Specialty Area	Institution	Rank	Type of Position	Degree-Year	Years of Experience	Courses to teach	Expected Academic Load in credits	Expected Number of Preparations
Arturo Portnoy	Analysis, applied mathematics and mathematics education	Rensselaer Polytechnic University	Professor	Permanent	1997	11		12	2
Julio Quintana	Applied Statistics and Mathematics Education	University of Wales	Professor	Permanent	1996	35		6	2
Héctor Rosario	Discrete Mathematics and Mathematics Education	Columbia University	Associate Professor	Probatory	2003	4		12	2
Olgamary Rivera	Mathematics Education	Virginia Polytechnic Institute and State University	Assistant Professor	Probatory	2007	1		12	3
Pedro Vásquez	Applied Mathematics and Mathematics Education	The George Washington University	Professor	Permanent	1997	11		12	3
Keith Wayland	Number Theory, Combinatorics and Mathematics Education	Louisiana State University	Professor	Permanent	1979	38		12	2

Table 1: Faculty profile

During recent years, several professors from the Department of Mathematical Sciences have obtained external funding for a variety of projects related to the preparation of mathematics teachers. These projects have provided professional improvement for in-service and pre-service mathematics teachers, pre-college and college mathematics students, graduate assistantships, classroom equipment and innovative materials for teaching mathematics. The following table lists some externally funded projects led by members of the Department of Mathematical Sciences at UPRM that are in progress or were recently completed.

Researcher	Name of the project	Agency	Amount	Period
Julio C. Quintana	Centro Comunitario para el Aprendizaje en Matemáticas, Tecnología, Inglés, Español (CCAMTIE)	Departamento de Educación de PR	\$240,850	2003-2004
Angel L. Cruz	Proyecto Access 2003(Universidad Interamericana Bayamón)	NASA MURED	\$100,000	2003-2004
Luis F. Cáceres	Competencia de Matemática	Departamento de Educación de PR	\$40,000	2003-2004
Luis F. Cáceres	Instituto para el Fortalecimiento de la Enseñanza de las Matemáticas (IFEM)	Departamento de Educación de PR	\$112,850	2003-2004
Luis F. Cáceres	Hacia una Cultura Matemática	Departamento de Educación de PR	\$135,000	2003-2004
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	“Alianza para el Fortalecimiento del Aprendizaje de las Ciencias y las Matemáticas” (AFAMaC)	Departamento de Educación de PR	\$6,906,895	2004-2008
Arturo Portnoy, PI y Luis F. Cáceres, Co-PI	Mathematical Re-Conceptions (REMA)	Departamento de Educación de PR	\$530,250	2004-2005
Angel L. Cruz	Proyecto Access 2004 (Universidad Interamericana Bayamón)	NASA MURED	\$100,000	2004-2005
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Aprobación de la propuesta Olimpiadas Matemáticas de Puerto Rico	Administración Central de la UPR	\$28,000	2005-2006
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Campamento de Verano para Niños Talentosos en Matemáticas	Epsilon Fund de la AMS	\$7,000	2005-2006
Edgar Acuña	Equipment Acquisition for Improving Research in Computational and Statistical Learning for Knowledge Discovery and Data Mining”	NSF	\$112,952	2005-2008
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Réplica de AFAMaC para otros maestros	Departamento de Educación de PR	\$560,000	mayo de 2006 a septiembre de 2006
Inglés: Betsy Morales, Español: Miriam González, Matemáticas: Arturo Portnoy y Luis F. Cáceres	Escuelas Superiores de Yauco: Maestros de excelencia en Inglés, Español y Matemáticas, Presupuesto, Periodo: Coordinadores:	Departamento de Educación PR	\$131,800	marzo-junio de 2006
Luis Cáceres, PI, Co-PI: Dámaris Santana y Omar Colón	Puerto Rico Experiences in Mathematics and Undergraduate Research PREMUR) at the University of Puerto Rico	REU (<i>Site Proposal to the National Security Agency</i>)	\$93,000	Verano 2007

Researcher	Name of the project	Agency	Amount	Period
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Aprobación de la propuesta Olimpiadas Matemáticas de Puerto Rico	Administración Central de la UPR	\$13,000	2007
Inglés: Betsy Morales, Español: Miriam González, Matemáticas: Arturo Portnoy y Luis F. Cáceres	Escuelas superiores de Yauco: Maestros de excelencia en Inglés, Español y Matemáticas, Presupuesto, Periodo: , Coordinadores:	Departamento de Educación de PR	\$98,000	marzo-junio de 2007
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Campamento de Verano para Niños Talentosos en Matemáticas	Epsilon Fund de la AMS	\$7,000	2005-2006
Edgar Acuña	Equipment Acquisition for Improving Research in Computational and Statistical Learning for Knowledge Discovery and Data Mining”	NSF	\$112,952	2005-2008
Luis F. Cáceres, PI y Arturo Portnoy, Co-PI	Réplica de AFAMaC para otros maestros	Departamento de Educación de PR	\$560,000	mayo de 2006 a septiembre de 2006

IX. Program Administration

The Chair of the Department of Mathematical Sciences is responsible for the current program’s management. An assistant chair and an undergraduate program coordinator share responsibility for directing the Department and managing its programs. The UPRM Secondary Education Teacher Preparation Program (PPMES) offers education foundations and general pedagogy courses. The PPMES also coordinates the methodology and teaching practice courses for all the secondary education programs at UPRM other than Agricultural Education. With respect to the current Mathematics Education program, this means that PPMES is responsible for providing the education foundations courses, the general pedagogy courses and managing teacher candidate school placement; selecting and evaluating cooperating teachers, and recruiting and evaluating university supervisors for student teachers. No change in this shared responsibility for the Mathematics Education program is contemplated in this proposed revision.

X. Information Resources

UPRM’s General Library adequately supports the bibliographic needs of the program’s faculty and students. The General Library's electronic databases have made more journal articles of interest available and more readily accessible. In addition to the General Library's collection of books and journals in education, the CRUISE (Centro de Recursos Universitario de Investigación y Servicios Educativos in Spanish - http://educon.uprm.edu/pccpe_cruise.html) holds 1200 titles in Teaching Mathematics.

Existing information technology resources adequately support the program needs. For a listing of education books and journals available in UPRM libraries see appendices. Further technological enhancements will be financed via external funds obtained through competitive grants.

XI. Infrastructure for teaching, research and service:

The Department of Mathematical Sciences has continuously offered three undergraduate programs and three graduate programs while serving in excess of 7,000 students per semester from the general student body with its present infrastructure for teaching and research. This proposed revision does not present any significant new challenges in this regard.

XII. Student support services

The Assistant Chair of the Department of Mathematical Sciences serves as academic counselor to the students in each of the programs administered by the department. A students affair officer from the UPRM Secondary Education Teacher Preparation Program provides counseling on the PPMES requirements.

XIII. Catalogue and Dissemination

The second paragraph of the description of the Department of Mathematical Sciences that appears in UPRME undergraduate catalogue should be revised from

Current version

Courses in Computers Science are frequently updated to keep pace with this rapidly changing field. Statistics is emerging as an important component of the Department and a growing number of courses in this field are also available.

Revised version

Courses in Computers Science are frequently updated to keep pace with this rapidly changing field. Statistics is emerging as an important component of the Department and a growing number of courses in this field are also available. The UPRM Teacher Preparation Program has been fully accredited by the National Council for Accreditation of Teacher Education. The Mathematics Education

program has been nationally recognized by the National Council of Teachers of Mathematics¹.

XIV. Budget Plan

The implementation of the revised program will create no added operational costs for the Mathematical Sciences Department. A Mathematics Education program that is accredited by NCATE and fully recognized by the NCTM will, in fact, give the Mathematical Sciences Department a distinct competitive advantage in seeking external funds related to the preparation of highly qualified mathematics teachers. The Mathematical Sciences Department has been successful in obtaining external funds to support professional development of in-service mathematics teachers and to prepare materials for teaching mathematics.

In recent years, improving student learning achievement in mathematics has been identified in several national task force reports as a matter of high priority. See Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future from the Committee on Prospering in the Global Economy of the 21st Century (http://www.nap.edu/catalog.php?record_id=11463); Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5 from the United States National Academies Press (<http://globalhighered.wordpress.com/2010/09/23/rising-above-the-gathering-storm-revisited-rapidly-approaching-category-5/>); Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century. The political concern raised by these reports and others about the nation's declining ability to compete in the global economy is expected to generate new opportunities for working with the improvement of mathematics instruction at all levels.

XV. Program Assessment Plan

To assess the effectiveness of the revised Mathematics Education program the Department of Mathematical Sciences will take into account:

1. The number of students admitted to the program. This will include and distinguish students admitted to the program as freshmen as well as transfer students within the UPRM campus and from the UPR system.

¹ In order to be certified to teach mathematics in Puerto Rico, program graduates must meet the requirements established by the Puerto Rico Department of Education that are in effect at the time certification is solicited. See <http://de.gobierno.pr/tags/certificacion-de-maestros>.

2. Longitudinal analysis of the total enrollment in the program, including retention and graduation rates.
3. Percent of students in the program completing the mathematical analysis sequence MATE 3031, MATE 3032, and MATE 3063 within two years of initial enrollment in MATE 3031.
4. Percent of students in the program approving MATE 3020 within a year of completing MATE 3063.
5. Proportion of students in the program taking the theory and methodology course, EDPE 4145, by the first semester of their fourth year in the program
6. Average time to complete the degree.
7. Percent of graduates approving the PCMAS Mathematics Specialization Test and the performance of UPRM Mathematics Education graduates on the test relative to the population tested.
8. Sufficiency of the installation and resources assigned to the program, such as, student support systems, and appropriate access to bibliographical and technological resources.
9. Learning outcomes assessment within the UPRM Teacher Preparation Program Assessment System (see <http://sites.google.com/site/irncateuprm/uprm-institutional-report/standard-2-assessment-system-and-unit-evaluation>). This includes program completer exit surveys and follow-up surveys of program graduates.
10. Faculty development of externally funded projects related to the teaching and learning of mathematics. The participation of Mathematics Education students in these projects and other projects to enhance the teaching and learning of mathematics in the community.

XVI. Development Plan

The recruitment of an additional faculty member with Mathematics Education background will be a high priority for the Department at its next opportunity to hire new or replacement faculty members

XVII. References

NCTM NCATE Mathematics Program Standards and Indicators for Secondary Mathematics Specialists available at http://www.nctm.org/uploadedFiles/Math_Standards/NCTMSECONStandards.pdf.

Model Standards in Mathematics for Beginning Teacher Licensing & Development: A Resource for State Dialogue developed by the Interstate New Teacher Assessment and Support Consortium Mathematics Sub-Committee available at <http://www.ccsso.org/content/pdfs/INTASCMathStandards.pdf>.