CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

# SINGLE SUBJECT MATHEMATICS

## Submitted to California Commission on Teacher Credentialing

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# SINGLE SUBJECT IN MATHEMATICS DOCUMENT

**Matrix 1: CCTC Single Subject in Mathematics Standards by Courses**

# Standards Common to All

**Standard 1: Program Philosophy and Purpose**

The subject matter preparation program is based on an explicit statement of program philosophy that expresses its purpose, design, and desired outcomes in relation to the Standards of Quality and Effectiveness for Single Subject Teaching Credential Programs. The program provides the coursework and field experiences necessary to teach the specified subject to all of California's diverse public school population. Subject matter preparation in the program for prospective teachers is academically rigorous and intellectually stimulating. The program curriculum reflects and builds on the State-adopted *Academic Content Standards for K-12 Students* and *Curriculum Frameworks for California Public Schools.* The program is designed to establish a strong foundation in and understanding of subject matter knowledge for prospective teachers that provides a basis for continued development during each teacher's professional career. The sponsoring institution assigns high priority to and appropriately supports the program as an essential part of its mission.

The single subject-subject matter programs at California State University Channel Islands (CSUCI) are constructed on the belief that all teachers require strong foundational content knowledge to be effective. The type of content knowledge we desire for future teachers requires not only a breadth in their content area but also a depth in a concentration or specialization within the discipline. To this end, students in the undergraduate subject matter programs are majors in the discipline and meet all of the requirements of their peers who are not entering a teacher preparation program. Mathematics faculty believes that it is a real strength of the program that all single subject math credential candidates must be math majors. That insures the depth of content knowledge. Also our students will be enculturated into the mathematical community and fully functional as a "disciplinary experts and practitioners."

Each subject matter program at CSUCI is purposefully designed to be in alignment with the *Academic Content Standards for K-12 Students* and *Curriculum Frameworks for California Public Schools* in preparation for the Single Subject Teaching Credential Program. In preparing future secondary teachers each discipline exposes the candidate to the content knowledge, beliefs, and skill sets necessary for enculturation in the disciplinary community. Since the state Algebra I requirement for high school graduation and the high stakes CAHSEE (California High School Exit Exam) are currently implemented, all Single Subject Math teachers will need multiple instructional strategies for helping all students meet the standards. They will also need lots of intervention and remediation strategies, since the expectation is for all students, special education included.

Traditionally, school curriculum has been grounded in the academic notion of knowledge abstracted from the situations in which it is learned and used. Modern cognitive studies, drawing especially on research of everyday activity, suggest that the activity in which knowledge is developed and deployed is an integral part of what is learned. Concepts, in other words, are tools that can be understood through continued use. Communities of practitioners use tools, so learning involves enculturation into such communities. To learn concepts, then, students must

enter into a community and its culture by engaging in authentic activity (that is, the ordinary practices of a culture).

According to Geertz (1983) academic disciplines are bound by intricate, socially constructed belief webs—more than a series of tasks. Through participating in the authentic activities associated with the discipline, candidates in the single subject matter programs are immersed in the culture of the discipline and the use of the specific disciplinary tools as a way of understanding the world (Brown, Collins, & Duguid, 1989). This collection of content knowledge, beliefs, and skills will be the foundation for the future learning of additional content and pedagogy preparation to be a secondary teacher through an approved single subject credential program. The candidates will learn how to think and view the world as a disciplinary expert or practitioner and candidates will be exposed to schooling and school cultures in their subject matter program. These interactions will be essential in their beginning understandings of how subject matter representation and meaning is different in a classroom environment (Lave, 1988).

**References**

Brown, J.S. Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32-42.
Geertz, C. (1983). *Local knowledge*. New York: Basic Books.
Lave, J. (1988). *Cognition in practice*. Boston, MA: Cambridge.

Required Elements

1.1 The program philosophy, design, and intended outcomes are consistent with the content of the State-adopted Academic Content Standards for K-12 students and Curriculum Frameworks for California public schools.

The BS Mathematics program at CSU Channel Islands provides subject matter based on the State-adopted *Academic Content Standards for K-12 Students* and *Curriculum Frameworks for California Public Schools*. The program accommodates students interested in pursuing Single Subject Matter Credential in Mathematics by providing flexible academically rigorous and intellectually stimulating instruction, covering all branches of modern mathematics. The program will prepare well-rounded teachers, familiar with current issues in contemporary mathematics and its applications, mathematical methods and educational technology, as well as an introductory teaching experience.

All Mathematics Majors are required to take the standard Calculus sequence (MATH 150,151, 250, followed by Differential Equations (MATH 250), Real Analysis (MATH 351) and Complex Analysis (MATH 452). These courses provide an in-depth understanding of the concepts of functions and their properties, graphing, analytic problem solving, and real and complex number systems.

The sequence containing Logic (Math 230) and Discrete Mathematics (MATH 300) provides competency in rigorous thinking, proof writing and combinatorial methods. Calculus-based

Probability and Statistics (MATH 342) offers an in-depth understanding of modern probabilistic and statistical methods, and Linear Algebra (MATH 230) covers vector spaces and matrices. All mathematics majors have to take History of Mathematics (MATH 331), which gives students an understanding of and a chance for reflection on, the complexity of the development of mathematics, as well as problem solving experiences in different historical contexts.
Mathematics majors planning to teach follow the same schedule as other majors, however they are required to complete the Emphasis in Education within the Mathematics program. This track includes Mathematics for Secondary School Teachers (MATH 318) where, in a technology-based environment, students learn modern geometry; Abstract Algebra (MATH 393), where algebraic structures and properties of various number systems are covered; and EDUC 512 Equity, Diversity and Foundation of Schooling, where the cultural and ethnic issues in contemporary education are discussed. MATH 492 Internship provides a chance for supervised teaching experience in a 6-12 school setting.
For increased depth, mathematical connections, and interdisciplinary applications all mathematics students choose several mathematics electives that require higher level mathematical skills. For example: MATH 320 Mathematics and Fine Arts (an elective recommended for Education Emphasis) connects the fields of arts and architecture with abstract thinking, algebra and geometry; MATH 482 Number Theory and Cryptography (includes modern applications of prime numbers); and MATH 430 Research Design and Data Analysis, presents statistical methods in an applied setting.
Calculus-based General Physics and two additional science courses provide a broader view on the sciences and give an insight to application of mathematics. Two computer science courses (one in programming), give the students an understanding and skills in modern technology.
Additionally, all students are required to take an English course (written and oral communication), and one general education interdisciplinary course (university-wide requirement).

MATH 499 Senior Colloquium is a capstone course, where students prepare written and oral presentations on their internship and research projects.

Please refer to the Matrix 1 on page 3 and Mathematics BS Degree Information Chart, Appendix A for details.

1.2 The statement of program philosophy shows a clear understanding of the preparation that prospective teachers need in order to be effective in delivering academic content to all students in California schools.

All Mathematics Majors at CSUCI follow a very rigorous course of study. The core (required) courses cover the subject matter in depth, and go beyond the State-adopted *Academic Content Standards for K-12 Students* and *Curriculum Frameworks for California Public Schools*.
In MATH 318, Mathematics for Secondary School Teachers (a geometry-based course), the students following the Emphasis in Education receive additional insight into mathematics teaching methods, pedagogy, and some classroom experience. Since the state Algebra I

requirement for high school graduation and the high stakes CAHSEE (California High School Exit Exam) are currently implemented, the class will introduce Single Subject Math teachers to multiple instructional strategies for helping all students meet the standards. EDUC 512 Equity, Diversity and Foundation of Schooling, prepares students for effective teaching in culturally, historically, and ethnically diverse schools. It includes studies of gender bias, various student abilities to learn, and diverse community and family values. MATH 492 Internship places students in supervised 6-12 mathematics classrooms, where they observe teachers and students, reflect on lessons and teaching strategies, teach selected topics, develop curriculum, collect data, and write journals on their own learning of the profession. The summary of their internship projects is presented in oral and written form at the student colloquium (MATH 499) and discussed by their peers and the faculty.

1.3 The program provides prospective teachers with the opportunity to learn and apply significant ideas, structures, methods, and core concepts in the specified subject discipline(s) that underlies the 6-12 curriculum.

Matrix 1 on page 3 provides an overview of the way the program provides prospective teachers with the opportunity to learn and apply significant ideas, structures, methods, and core concepts in mathematics that underlie the 6-12 curriculum.
The courses in English and MATH 230 Logic provide the basis for the effective communication in mathematics, critical thinking, and an introduction to proofs (that is included to various degrees in all courses in the core, and is seriously implemented in MATH 351 Real Analysis and MATH 393 Abstract Algebra courses). All of the major content domains coming from the standards are covered by more than one course, which gives the students a chance to see the same concept in various contexts and possibly in different applications. Mathematics electives and additional required courses provide a broader point of view and various applications of mathematical methods, while the MATH 331 History of Mathematics course provides wider historical contexts for mathematics development. MATH 318, EDU 512, and MATH 492 give students perspective on, reflection of, and experience in teaching mathematics curriculum to various audiences.

1.4 The program prepares prospective single-subject teachers to analyze complex discipline-based issues, synthesize information from multiple sources and perspectives, communicate skillfully in oral and written forms, and use appropriate technologies.

The program provides prospective single-subject mathematics teachers with a very solid background in mathematics that is put in various contexts through applications and interdisciplinary connections (through the required science courses, computer science courses, broad mathematics electives, and the university interdisciplinary course). The abstract courses such as Abstract Algebra, Real Analysis, Complex Analysis, Differential Equations, and Probability, to name a few, teach students how to analyze complex, abstract, and difficult situations, and how to present the solution in a comprehensible way. The interdisciplinary courses and mathematical applications to other fields that are part of almost every course in the program teach how to synthesize information from multiple sources and perspectives, and stress

graphical methods (by the use of graphical tools such as graphic calculators, and other modern data analyzing and display mathematical software such as SPSS, Maple, MathLab, Geometry Sketch Pad when appropriate). While communication skills, critical thinking, and proof writing are stressed throughout the program, MATH 499 Senior Colloquium includes written, oral, and computer-based presentation skills.

1.5 Program outcomes are defined clearly and assessments of prospective teachers and program reviews are appropriately aligned.

The Mathematics Program at CSUCI has a clear organizational structure that forms a logical sequence of courses and other instructional components, (please see the Mathematics BS Degree Information Chart, and the Program Catalog Description in Appendix A). We have designed a course of study that gives our graduates a very solid background in mathematics, with many interdisciplinary applications, broad connection to other disciplines, and a wide variety of pedagogical experiences. Our graduates will be problem solvers and project-oriented mathematics teachers, who are reflective practitioners, with a belief that all children can learn. They will be flexible, positive, and compassionate, with a willingness to reflect critically, and are ethical decision makers who embrace the diversity of our student population. We have designed a program that will enable our candidates to experience a variety of teaching methodologies and become well grounded in the realities of being a teacher. The following are specific program goals and objectives as stated in our New Program Proposal for BS in Mathematics at CSUCI (also in Appendix A)

**Program Goals:**

1. Provide students with the opportunity to earn a state-supported Bachelor degree in Mathematics from the California State University.
2. Prepare students for employment in a variety of highly sophisticated and complex high-tech and bio-tech industries, as well as in mathematics education.
3. Prepare students for further study in graduate or professional schools.
4. Offer all CSUCI students the opportunity to broaden their knowledge and learn in this subject area.
5. Through interdisciplinary courses and emphasis offers students an understanding of various applications of mathematical sciences in other fields

**Program Learning Objectives:**

Students will:

1. Demonstrate critical thinking, problem solving skills and ability to use advanced mathematical methods by identifying, evaluating, classifying, analyzing, synthesizing, data and abstract ideas in various context s and situations.

2. Demonstrate the knowledge of current mathematical applications, computing practices and broad technology use in industry, science and education.

3. Demonstrate ability to use modern software, abstract thinking, and mathematical practices connected to scientific and industrial problems, and demonstrate

mathematical/statistical/computing skills that are currently used by technologies in society and education.

4. Demonstrate cooperation skills by working effectively with others in interdisciplinary group settings – both inside and outside the classroom.

5. Demonstrate a sense of exploration that enables them to pursue rewarding careers in mathematics, statistics, education, high-tech and bio-tech industries with life-learning.

Integrated throughout the program are opportunities for students to interact with others, to learn how to work collaboratively, to work at school sites which are linguistically and culturally diverse, to work closely with the Cooperating Teacher and a University Supervisor to ensure timely feedback on performance, and to take classes from highly qualified faculty who have spent a considerable amount of time in the schools.

Each specific course has a syllabus that provides information on prerequisites, course outcomes, and various ways of evaluating student work (through team work, homework, projects, testing, presentations, problem solving, on-line research, graphical displays, etc.). Each student's assessment is done individually in every course on the basis of work in the particular topic area and overall evaluation of students skills is provided through a capstone Senior Colloquium MATH 499, and MATH 492 Internships (field experiences) when the final assessment of graduating students skills and competencies is done. The Mathematics Program will conduct regular reviews of its faculty, teaching effectiveness, student preparation for teaching careers, and the alignment of the program with the educational and mathematical community's directives.

1.6 The institution conducts periodic review of the program philosophy, goals, design, and outcomes consistent with the following: campus program assessment timelines, procedures, and policies; ongoing research and thinking in the discipline; nationally accepted content standards and recommendations; and the changing needs of public schools in California.

As a start-up University, we have had the opportunity to plan an initial approach to evaluation of our Programs. The CSUCI Mathematics program takes the evaluation of all of its aspects very seriously. The relevance and content of courses offered, the expertise of the faculty, the methodology and technology used, services to students, and the success of those completing the program are of great importance to the faculty. Therefore, the approach to program evaluation and program development is an ongoing, multidimensional endeavor, involving continuous input from students, faculty and the community, as well as, the public schools that we serve.

Our evaluation efforts parallel those of the university. In the Universities Institutional Proposal for Candidacy Review Submitted to WASC on February 18, 2002, it describes an approach to institutional assessment based upon each unit of the university "identifying goals, identifying outcomes, and developing appropriate measures to assess the achievement of goals and

outcomes. Furthermore, each will be required to show how assessment and evaluations are used to (a) inform strategic planning, (b) set priorities, (c) guide budgeting, and (d) improve the University's programs, services and administrative functions. The University is in the process of assessing the learning outcomes for the first courses taught in Fall 2002 – and other courses as they are brought on-line .

**Mathematics Program Evaluation**

**By the CSU Chancellor's Office Reviewers**

The Mathematic Program went through a systematic internal and external review in 2002, after it was first proposed for the University Master Plan and then after it was designed. Internal reviewers included CSUCI Mathematics and Science Faculty, the University Curriculum Committee, the University Senate, and the University President. Then the program was reviewed by the CSU Chancellor's Office Reviewers, both internal (CSU Mathematics Faculty) and external (UC and other mathematicians). All reviews were very positive and the Mathematics Faculty was very pleased with all the comments. The CSU regularly conducts program evaluations across the system.

**By Faculty**

Faculty will meet regularly, formally and informally, to assess programs. This approach will provide an opportunity for them to give feedback regarding their experiences and to make suggestions for possible changes or modifications to the program. Faculty members discuss program issues and explore changes or modifications that enhance the relevance of the curriculum. The program faculty communicates with adjunct faculty for the same purpose. Discussions also focus on program modifications that reflect CCTC standards and an optimum integration and coordination of assignments and readings across courses. The Mathematics Program will work to improve consistency so students receive the highest standard for the course of instruction as well as field experience. In addition, we are committed to the infusion of language, communication skills, interdisciplinarity, and technology across the curricula and pledge to include these competencies in all courses. The syllabus for each course includes specific student learning outcomes. Mathematics faculty meets regularly to examine consistency and articulation across the various courses. Faculty are preparing a pilot program evaluation and assessment project to be implemented by all university programs during 2004. It will involve collectively analyzing student achievement, surveys, and program evaluations.

**By Graduates and Employers**

We are developing a variety of approaches to evaluation by our program graduates and employers. Our intent is to work in consultation with our area districts to conduct follow-up surveys of graduates and employers. To that end, the Mathematics and Education Program faculty meets regularly with members of the 6–12 community to gain their perspective and insights into the implementation of our program – this is our initial plan to gain evaluation feedback to indicate focal areas for our program. For example, cooperating teachers provide

ongoing input into the implementation of the fieldwork/student teaching component. We envision that these evaluations will be done regularly and consistently to guide implementation and long-range program development and revision. We will participate in the process developed by the CSU Chancellor's Office that entails an annual survey of all first-year credential program graduates and their principals. This program evaluation plan will provide a comprehensive, systematic, and continuous evaluation of all our mathematics teacher education programs. This program evaluation will be implemented with our first graduates in spring 2004.

**By the Students**

Students complete program evaluation forms at the completion of their BS in Mathematics degree. The results of the program evaluations are compiled, and a summary is given to the instructors and Program Coordinator. This information is used in making course and program modifications on a continuous basis. In keeping with the University's assessment priorities, these evaluations focus on the learning outcomes expected for each course or field experience. Additionally, students provide evaluation input into each course they complete through university-wide course evaluation procedures. The course evaluation solicits input from the students on the utility and effectiveness of a given course and provides additional feedback specific to the instructor's teaching.

**Program Development and Revision**

Program development and revision will be ongoing at CSUCI. Program administrators and faculty members will utilize follow-up studies, final assessment, and course evaluations, assessments from field experience site supervisors, formal and informal discussions with students and faculty, and feedback from the community for input and direction regarding program development. Mathematics Faculty Meeting minutes will provide evidence of continuous program and curriculum review and modification. The Education Advisory Committee will be presented with the evaluation data annually in order to provide clear direction and feedback to the University about the impact of its students and programs on the local educational community.

**Standard 2: Diversity and Equity**

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| The subject matter program provides equitable opportunities to learn for all prospective teachers by utilizing instructional, advisement, and curricular practices that insure equal access to program academic content and knowledge of career options. Included in the program are the essential understandings, knowledge, and appreciation of the perspectives and contributions by and about diverse groups in the discipline. |

Required Elements:

2.1 In accordance with the Education Code Chapter 587, Statutes of 1999, (See Appendix A), human differences and similarities to be examined in the program include, but are not limited to those of sex, race, ethnicity, socio-economic status, religion, sexual orientation, and exceptionality. The program may also include study of other human similarities and differences.

The CSUCI Mathematics program is committed to the preparation of teachers for the 21st Century to serve the needs of all children, regardless of their background and ethnicity. Mathematics as a universal language of science is a perfect vehicle for leveling the field for students with diverse needs.

CSUCI general education requirement include a course with a multicultural component to assure that students were exposed to current issues of a multicultural society. All undergraduate students at CSUCI must be certified in General Education (GE) upon graduation. All students have a three unit multicultural course in their General Education Requirements—Category C3b. The criteria for Category: C3b Multicultural Courses are:

"1) address issues, "ways of knowing", and perspectives from at least two cultures, where a culture is broadly defined to include aspects of ethnicity, class, gender, ability/disability, and community;

2) involve students with other cultures in an in-depth way, not simply observing a culture from the outside, as in a survey of other cultures."

Additionally, Category D: Social Perspectives requires the following criteria be met for inclusion in the General Education Program:

"1) Promote understanding of how the issues relevant to social, political, contemporary/historical, economic educational, or psychological realities interact with each other within the realm of human experience;

2) focus on how a social science discipline conceives and studies human existence;

3) address issues using the methods commonly employed by a social science discipline."

Students at CSUCI must have 12 units in Category D.

Students must complete three units in GE Category E: Human Physiological and Psychological Perspectives. The criteria for courses to be included in this category are:

"1) Focus on some aspect of human physiology, psychology, health, or physical activity; 2) promote an understanding that humans, as physiological and psychological beings, exist and live in a social and physical environment."

Within the BS in Mathematics program with Emphasis in Education *Mathematics for Secondary School Teachers* (MATH 318) course—a geometry-based course with a large teaching methods component— students are provided with various problem solving techniques (using technology, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc.) to accommodate students with various learning skills, language competency, or special needs. In this class, through a series of teaching assignments, students have a chance to practice variety of pedagogy in various settings (through tutoring, small teaching assignments at local public schools and the campus University Preparatory School (currently K-5, but soon to be K-8), and other local educational institutions). Since the state Algebra I requirement for high school graduation and the high stakes CAHSEE (California High School Exit Exam) are currently implemented, all Single Subject Math teachers will be introduced to multiple instructional strategies for helping all students meet the standards. They will also need lots of intervention and remediation strategies, since the expectation is for all students, special education included. In EDUC 512 Equity, Diversity and Foundation of Schooling course the cultural and ethnic issues in contemporary education are discussed.

The GE Category D History of Mathematics (MATH 331) required course presents mathematical achievements of different societies and diversity of scientists involved in progress of the mathematical thought. Through dialogs, activities, assignments, and projects it teaches (among other things) an attitude of acceptance and inclusion of all people regardless of race, ethnicity, background, and origin.

2.2 The institution recruits and provides information and advice to men and women prospective teachers from diverse backgrounds on requirements for admission to and completion of subject matter programs.

CSUCI opened to transfer students in the 2002-2003 Academic Year. As programs are being developed and begin coming on-line, information is disseminated to students through both formal and informal means. Formally, there are five to six campus-wide advising sessions for prospective students each year. Beginning the 2003-2004 AY there were ten majors and seven minor-only programs for continuing transfers, new transfers, and freshman to select for their area of study. Three majors (Biology, English, and Mathematics) are submitting documents for subject matter programs to the CCTC for review and initial approval. Faculty associated with these majors has been advising students both formally and informally on the prospective subject matter programs. As the programs are being developed and finalized informational meetings will be scheduled during the spring semester for students wishing to be admitted into the subject matter programs.

CSUCI resides in a diverse region in California and therefore, our student population is representative of the county. Please refer to the table below for the breakdown of Ventura County K-12 student population by ethnicity.

**Students by Ethnicity**
**Ventura County, 2002-03**

| | Student Enrollment | Percent of Total Enrollment | Percent of Total County Populations |
|---|---|---|---|
| **American Indian** | 1,208 | 0.8% | 0.9% |
| **Asian** | 5,221 | 3.6% | 8.1% |
| **Pacific Islander** | 515 | 0.4% | 0.7% |
| **Filipino** | 2,890 | 2.0% | 2.5% |
| **Hispanic** | 64,459 | 44.7% | 45.2% |
| **African American** | 3,318 | 2.3% | 8.3% |
| **White** | 66,181 | 45.8% | 33.7% |
| **Multiple/No Response** | 560 | 0.4% | 0.8% |
| **Total** | **144,352** | **100%** | **100%** |

Students by Ethnicity **Source:** Educational Demographics Office, CBEDS (sifae02 5/7/03)

Additionally, the Division of Student Affairs has an outreach program that recruits students from local high schools and community colleges. The University Outreach Program is an early academic outreach program aimed at preparing and motivating low income and educationally disadvantaged elementary and middle school students to pursue and successfully complete a post-secondary education. The goal of the program is to offer positive reinforcement to develop a commitment to higher education, the resources and awareness of educational options, and encouragement for students to plan and prepare academically and financially for college. An additional part of the outreach program is advising students of their career options at Channel Islands with special attention to pathways leading to a teaching credential. CSUCI is committed to serving all students in Ventura County with a special emphasis on recruiting first generation college students.

2.3 The curriculum in the Subject Matter Program reflects the perspectives and contributions of diverse groups from a variety of cultures to the disciplines of study.

The CSUCI Mathematics program is committed to the preparation of teachers to serve the needs of all children regardless of their background and ethnicity. Mathematics as a universal language of science is a perfect vehicle for leveling the field for students with diverse needs. Mathematics for Secondary School Teachers (MATH 318) is a geometry-based course with a large teaching methods component. In this class students solve a problem in several different ways (using technology, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc.) to accommodate students with various learning skills, language competency, or special needs. Through a series of service learning teaching assignments, students have a chance to practice a variety of pedagogy in diversified, multi-ethnic, multi-

cultural settings (through tutoring, small teaching assignments at local public schools and the university school, and other local educational institutions).

History of Mathematics (MATH 331) is a required course for all mathematics majors. It presents mathematical achievements of different societies and diversity of scientists involved in progress of the mathematical thought. Through dialogs, activities, assignments and projects it teaches an attitude of acceptance and inclusion of all people regardless of race, ethnicity, background, and origin. The historical perspective on the development of mathematics through the centuries and with analysis of contributions of various cultures, gives students a broad view and understanding of the need for the cultural cooperation in sciences, the international nature of human thought, and the need for preservation of achievements and cultivation traditions across the globe.

CSUCI General Education requirements include courses with multicultural components to assure that students are exposed to current issues of a multicultural society.

2.4 In the subject matter program, classroom practices and instructional materials are designed to provide equitable access to the academic content of the program to prospective teachers from all backgrounds.

Mathematics program makes a special effort to accommodate students from all backgrounds. Equitable access to instruction is assured through various pedagogical techniques (using technology based instruction, graphic tools, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc.) and the use of various on-line technologies. All mathematics students are required to take two computer science courses (at least one of them is a programming course) to assure that they are computer literate and able to use suitable software and internet resources as computational and educational tools. The use of web-based instructions or Blackboard software is expected in all courses. Students requiring additional help may use the services of the university-wide Writing Center, Mathematics Tutoring Center, and computer labs that offer free assistance and tutoring. All faculty hold regular office hours to academically assist students outside of the classroom.

Students with special needs are referred to the C.H.A.P.s. office, which stands for: **C**areer Development; **H**ealth; **A**ccommodations for students with disabilities; **P**ersonal Counseling; **S**ervices. The Mission of the Office of C.H.A.P.s is to prepare students to meet the challenges of the real world that exist inside and outside the classroom. It focuses on the development of the whole student in mind, body, and spirit, and provides service and learning opportunities that advance the student's overall development. It accomplishes this mission by:

- Providing comprehensive career development services to help students integrate their educational experiences with lifelong learning and career opportunities through effective academic/career decision-making, planning, and job search;
- Improving student achievement by identifying and reducing health barriers to learning through student health promotion and disease and injury prevention;
- Assisting students with disabilities to realize their academic and personal potential through quality student services that comply with Section 504 of the Federal Rehabilitation Act of 1973 and the American with Disabilities Act (ADA) of 1990;

- Providing counseling services that facilitate the social-emotional adjustment of students who experience life challenges that interfere with personal growth and adjustment to university life.

2.5 The subject matter program incorporates a wide variety of pedagogical and instructional approaches to academic learning suitable to a diverse population of prospective teachers. Instructional practices and materials used in the program support equitable access for all prospective teachers and take into account current knowledge of cognition and human learning theory.

All faculty at CSUCI are valued and retained for their commitment to teaching. The University Retention, Tenure, and Promotion document lists teaching as the primary focus for all CSUCI professors. Standard 2.2 detailed the diversity of ethnic groups in Ventura County and Channel Islands professors are aware of current learning theory and strive to make all content accessible to all students.

Faculty are encouraged to try new teaching techniques including teamwork, group discussions, various pedagogical techniques, technology-based instruction, graphic tools, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc. and the use of various on-line technologies. The use of web-based instructions or Blackboard software is expected in all courses.

The Instructional Computing Labs consist of two classrooms, which are used for scheduled classes; one has 30 Macintosh computers and the other has 35 PCs. A third computer lab is open to students six days per week. A standard list of mathematical applications including graphing and computational tools (such as graphic calculator, MathLab), geometry software (Geometry Sketch Pad, Graphical tools), statistical software (SPSS, SAS) is available to support instruction and students' work. Additional software applications are loaded at the request of faculty to support individual courses. The standard academic software package decisions are made by the appropriate faculty.

**Standard 3: Technology**

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| The study and application of current and emerging technologies, with a focus on those used in K-12 schools, for gathering, analyzing, managing, processing, and presenting information is an integral component of each prospective teacher's program study. Prospective teachers are introduced to legal, ethical, and social issues related to technology. The program prepares prospective teachers to meet the current technology requirements for admission to an approved California professional teacher preparation program. |

As a new and growing institution, CSUCI is developing its technology and technological resources as a 21st Century university. We are committed to offering a rigorous, collaborative subject matter preparation experience in a technologically rich context. Our future teaching candidates must be able to not only use current technologies but also be on the forefront of classroom innovation in applying those technologies to teaching 6-12 students.

Required Elements**:**

3.1 The institution provides prospective teachers in the subject matter program access to a wide array of current technology resources. The program faculty selects these technologies on the basis of their effective and appropriate uses in the disciplines of the subject matter program.

CSUCI undergraduate Mathematics curriculum is technology-based. For example: Calculus courses (MATH 150,151, 250), and Differential Equations (MATH 250) use graphing tools on an everyday basis, as well as more sophisticated computational software for assignments and problem solving; Mathematics for Secondary School Teachers (MATH 318) is a course where geometry is taught hands-on in a technology based environment; History of Mathematics (MATH 331) includes internet searches, maintenance of students web pages, electronic presentations and on-line assignments.
All mathematics majors are required to take two computer science courses – at least one includes computer programming.

The following resources are available for all students on campus:

Computer Facilities for Students
The Instructional Computing Labs consist of two classrooms which are used for scheduled classes. One lab has 30 Macintosh computers and the other has 35 PCs. A third computer lab with 11 Macintosh computers and 25 PCs is open to students six days per week. There are also two Computer Science dedicated labs (unix/linux and window based) for programming instructions (lat tutoring is available). In the Fall of 2004, the Mathematics program is expected to receive the mathematics dedicated lab (with 30-35 Mac stations). A standard list of mathematical applications including graphing and computational tools (such as graphic calculator, Maple, MathLab), geometry software (Geometry Sketch Pad, Graphical tools), and statistical software (SPSS, JMP IN, SAS) is available to support instruction and students' work. Additional software applications are loaded at the request of faculty to support individual

courses. The appropriate faculty makes the standard academic software package decisions for their courses.

Training for students

The University provides open lab facilities for students that are managed by full-time IT staff and trained student assistants. The software programs required for classes are available for check out or are loaded onto the computer lab machines. Several operating systems are available for student use and training in the library.

3.2 Prospective teachers demonstrate information processing competency, including but not limited to the use of appropriate technologies and tools for research, problem solving, data acquisition and analysis, communications, and presentation.

CSUCI undergraduate Mathematics curriculum is technology-based. All courses maintain their web pages and students often submit their work on-line. Computer-based graphing tools are used on an everyday basis across the mathematics curriculum. More sophisticated computational software for assignments and problem solving (such as MathLab or Maple) is used in more advanced classes. Statistics software (SPSS, SAS) is used in the Probability course and for various interdisciplinary projects. Mathematics for Secondary School Teachers (MATH 318) is a course where geometry is taught hands-on in a technology based environment; History of Mathematics (MATH 331) includes internet searches, maintenance of student's web pages, electronic presentations, and on-line assignments.

To ensure computer competency in future students endeavors all mathematics majors are required to take two computer science courses – at least one includes computer programming.

Additional Information Technology Resources

The University Library offers several reference and electronic resources that support research in education. These include dictionaries, handbooks, and encyclopedias. Representative titles include AskERIC (Educational Resources Information Center), California Department of Education (including STAR test results), Chronicle of Higher Education, Education Code, Education Week (Online Magazine), Statistical Abstracts of the United States, U.S. Department of Education Information, Reference Resources for Children's Literature, Young Adult Reading List, ERIC Clearinghouse on Assessment and Evaluation – Test Locator, ERIC Clearinghouse on Reading, English and Communication, and JSTOR.

CSUCI students will also have access to a variety of on-line curriculum materials, including Education Connection, Environmental Resources (K-12), History Resources, Institute for Learning Technologies (K-12 resources), MathMagic (K-12), Mathematical Problem Solving Strategies, NASA Space-link, Native American Indians, Parents and Children Together Online (online journal dealing with literacy), Quest! NASA's Technology and Literacy Page, Teachnet (The Teachers Network), and TEAMS Distance Learning – Resources for 6-12 Teachers.

3.3 In the program, prospective teachers use current and emerging technologies relevant to the disciplines of study to enhance their subject matter knowledge and understanding.

All mathematics majors at CSUCI are required to take two courses in Computer Science, at least one of them includes computer programming. Typically students take COMP 105—Introduction to Programming, or COMP 150—Object-Oriented Programming, as one of the courses. Starting in the fall of 2004, students will be able to take COMP 102—Web Development, which will introduce future teachers to web designing and basic Internet site development skills.

The entire Mathematics curriculum is technology-based, and computers are used when relevant and applicable. For example, all courses maintain their own web pages and students often submit their work on-line. Computer-based graphing tools are used on an everyday basis across the mathematics curriculum. More sophisticated computational software for assignments and problem solving (such as MathLab or Maple) is used in more advanced classes. Statistics software packages (SPSS, SAS) are used in the Statistics courses and for various interdisciplinary projects. Mathematics for Secondary School Teachers (MATH 318) is a course where geometry is taught hands-on in a technology based environment; History of Mathematics (MATH 331) includes internet searches, maintenance of student's web pages, electronic presentations, and on-line assignments.

**Standard 4: Literacy**

The program of subject matter preparation for prospective Single Subject teachers develops skills in literacy and academic discourse in the academic disciplines of study. Coursework and field experiences in the program include reflective and analytic instructional activities that specifically address the use of language, content, and discourse to extend meaning and knowledge about ideas and experiences in the fields or discipline of the subject matter.

Required Elements**:**

4.1 The program develops prospective teachers' abilities to use academic language, content, and disciplinary thinking in purposeful ways to analyze, synthesize, and evaluate experiences and enhance understanding in the discipline.

All mathematics majors are required to take as a part of their general education program an English Composition course, a Communication course, and an English Literature course. Several mathematics classes include extended written assignments. For example: Logic class (MATH 230) requires an extended essay on inductive and deductive logic; History of Mathematics (MATH 331) requires many written assignments, including a written midterm and final project on specific historical issues or results. Students interested in teaching in MATH 492 (field experience) are required to write daily journals reflecting on their experiences and pedagogy. All mathematics seniors are required to present their independent work in a written and oral form at the Senior Colloquium (MATH 499).

Problem solving, proof writing, and abstract thinking are the major themes across the mathematics curriculum that are being gradually developed and stressed in all the courses. Students are expected to learn how to communicate their mathematics to others, including their colleagues and pupils.

4.2 The program prepares prospective teachers to understand and use appropriately academic and technical terminology and the research conventions of the disciplines of the subject matter.

Mathematics students start their program at CSUCI with a course in Logic, which stresses the critical thinking, precision of expression, symbolic communication, and the idea of mathematical truth. Proof writing and communication of solution of various problems are the major themes across mathematics curriculum that are being gradually developed and stressed in all the courses. Students are expected to learn how to communicate their mathematics to the mathematical community, other scientists, their colleagues, teachers and pupils.

4.3 The program provides prospective teachers with opportunities to learn and demonstrate competence in reading, writing, listening, speaking, communicating and reasoning in their fields or discipline of the subject matter.

All mathematics majors are required to take as a part of their general education program an English Composition course, a Communication course, and an English Literature course. Several mathematics classes include extended written assignments. For example: Logic class (MATH 230) requires an extended essay on inductive and deductive logic; History of Mathematics (MATH 331) requires many written assignments, including a written midterm and final project on specific historical issues or mathematicians. Students interested in teaching in MATH 492 (field experience) are required to write daily journals reflecting on their experiences and pedagogy. All mathematics seniors are required to present their independent work in a written and oral form at the Senior Colloquium (MATH 499).

Faculty is encouraged to assign team projects, small group discussion, on-line research, and interdisciplinary work. These provide students with opportunities to communicate, read, write, listen, and reason in mathematics and related fields.

**Standard 5: Varied Teaching Strategies**

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| In the program, prospective Single Subject teachers participate in a variety of learning experiences that model effective curriculum practices, instructional strategies, and assessments that prospective teachers will be expected to use in their own classrooms. |

Required Elements**:**

5.1 Program faculty includes in their instruction a variety of curriculum design, classroom organizational strategies, activities, materials, and field experiences incorporating observing, recording, analyzing, and interpreting content as appropriate to the discipline.

The CSUCI Mathematics program is committed to the preparation of teachers for the 21st Century with modern teaching skills. Students are exposed to various teaching techniques through the program – from abstract, analytical thinking to hands-on technology explorations. The courses use various organizational strategies – from lecturing, individual and group projects, on-line instructions and chat rooms, to team work, group projects, and classroom discussions. Through the interdisciplinary courses students experience the application of mathematics to other scientific fields. In MATH 318 (Mathematics for Secondary School Teachers course with a large teaching methods component) students have a chance to experience and reflect on different ways of solving a problem, by using on-line based activities, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc. Students are made aware of varied teaching strategies to accommodate students with various learning skills, language competency, or special needs. Additionally, MATH 492 provides in school early field experience, observations, data collecting and analyzing experience, that has to be thought through and presented as a written and oral report in MATH 499. Please see the Matrix 2 in Appendix A and the course syllabi in Appendix B for specific examples.

5.2 Program faculty employs a variety of interactive engaging teaching styles that develop and reinforce skills and concepts through open-ended activities such as direct instruction, discourse, demonstrations, individual and cooperative learning explorations, peer instruction, and student-centered discussion.

CSUCI faculty is encouraged to assign team projects, small group discussion, peer instruction, on-line research, and interdisciplinary work. These expose students to a variety of interactive, engaging teaching styles that develop and reinforce skills and concepts through open-ended activities in mathematics and related fields. For example: GE Interdisciplinary courses are project-based, hands-on cooperative courses; MATH 499 is a discussion-based class, that requires students presentation; MATH 331 – History of Mathematics, is a discourse and discussion generating, reflection and problem solving class; MATH 300—Discrete Math—has many open-ended combinatorics-based activities. Please see the Matrix 2 in Appendix A and the course syllabi in Appendix B for specific examples.

5.3 Faculty development programs provide tangible support for subject matter faculty to explore and use exemplary and innovative curriculum practices.

Faculty is encouraged to try new teaching techniques including small group discussions, group work, and authentic activities. The Office of Faculty Development offers a wide array of resources and workshops for faculty to improve and refine their classroom practices to make content accessible to all students. Faculty is invited to teaching workshops every semester to learn valuable and innovative strategies to use in their teaching.

5.4 Program faculty uses varied and innovative teaching strategies, which provide opportunities for prospective teachers to learn how content is conceived and organized for instruction in a way that fosters conceptual understanding as well as procedural knowledge.

The Mathematics program is committed to modern teaching skills across curriculum. Students are exposed to various teaching techniques through the program – from abstract, analytical thinking, to hands-on technology explorations. For example, the calculus sequence stresses graphical methods and problem solving; Logic and Abstract Algebra focus on abstract thinking and reasoning; History of Mathematics provides mathematical reflections and historical context; Internship (MATH 492) stresses observation and reflections on mathematics pedagogy. MATH 318 Mathematics for Secondary School Teachers is a course with a large teaching methods component, students have a chance to experience and reflect on different ways of solving a problem by using on-line based activities, geometric software, visual displays, drawings, verbal descriptions, schematic representations, etc. It is one thing to present to other math majors and quite another to present to middle school and high school students with a wide range of abilities, hence MATH 318 students focus on grade appropriate presentations using multiple representations including graphing calculators, software, Geometer's Sketchpad, LabGear algebra tiles, etc. They are being made aware of varied teaching strategies to accommodate students with various learning skills, language competency, or special needs. Please see the course syllabi in Appendix B for specific examples.

5.5 Program coursework and fieldwork include the examination and use of various kinds of technology which are appropriate to the subject matter discipline.

All mathematics majors at CSUCI are required to take two courses in Computer Science, at least one of them includes computer programming. Typically students take COMP 105—Introduction to Programming, or COMP 150—Object-Oriented Programming, as one of the courses. Starting in the fall of 2004 students will be able to take COMP 102—Web Development, which will introduce future teachers to web designing and basic internet site development skills.

The entire Mathematics curriculum is technology-based, and computers are used when relevant and applicable. For example, all courses maintain their own web pages and students often submit their work on-line. Computer-based graphing tools are used on an everyday basis across the mathematics curriculum. More sophisticated computational software for assignments and problem solving (such as MathLab or Maple) is used in more advanced classes. Statistics software (SPSS, SAS) are used in the Probability course and for various interdisciplinary

projects. Mathematics for Secondary School Teachers (MATH 318) is a course where geometry is taught hands-on in a technology-based environment; History of Mathematics (MATH 331) includes internet searches, maintenance of student's web pages, electronic presentations, and on-line assignments.

**Standard 6: Early Field Experiences**

The program provides prospective Single Subject teachers with planned, structured field experiences in departmentalized classrooms beginning as early as possible in the subject matter program. These classroom experiences are linked to program coursework and give a breadth of experiences across grade levels and with diverse populations. The early field experience program is planned collaboratively by subject matter faculty, teacher education faculty, and representatives from school districts. The institution cooperates with school districts in selecting schools and classrooms for introductory classroom experiences. The program includes a clear process for documenting each prospective teacher's observations and experiences.

Required Elements**:**

6.1 Introductory experiences shall include one or more of the following activities: planned observations, instruction or tutoring experiences, and other school-based observations or activities that are appropriate for undergraduate students in a subject matter preparation program.

MATH 492 Internship gives students a chance to experience a 6-12 school mathematics teaching environment in an informal way as tutors, teacher helpers, math club leaders, etc. Projects are assigned and evaluated in cooperation with the school site-specific internship. Students are required to keep journals of their experiences and reflections, and to present their work at the capstone course - Senior Colloquium (MATH 499)

6.2 Prospective teachers' early field experiences are substantively linked to the content of coursework in the program.

MATH 492 Internship students are in their senior or junior year and design the mathematical content of their projects used in the early field experience. In cooperation with an academic advisor and a particular schools needs, the proposal is developed. The mathematical content is based on the undergraduate mathematical curriculum and 6-12 curriculum (typical projects: geometric transformations, combinatorics, number theory, functions, and graphic tools). Students teach the content supervised by an expert teacher and keep journals of their experiences. They are required to present the summary of their work at the Senior Colloquium.

6.3 Fieldwork experiences for all prospective teachers include significant interactions with K-12 students from diverse populations represented in California public schools and in cooperation with at least one carefully selected teacher certificated in the discipline of study.

CSUCI resides in a diverse region in California and therefore, our public school pupil population is representative of the county. Please refer to the table below for the breakdown of Ventura County student population by ethnicity.

**Students by Ethnicity,Ventura County, 2002-03**

| | Student Enrollment | Percent of Total Enrollment | Percent of Total County Population |
|---|---|---|---|
| **American Indian** | 1,208 | 0.8% | 0.9% |
| **Asian** | 5,221 | 3.6% | 8.1% |
| **Pacific Islander** | 515 | 0.4% | 0.7% |
| **Filipino** | 2,890 | 2.0% | 2.5% |
| **Hispanic** | 64,459 | 44.7% | 45.2% |
| **African American** | 3,318 | 2.3% | 8.3% |
| **White** | 66,181 | 45.8% | 33.7% |
| **Multiple/No Response** | 560 | 0.4% | 0.8% |
| **Total** | **144,352** | **100%** | **100%** |

Students by Ethnicity **Source:** Educational Demographics Office, CBEDS (sifae02 5/7/03)

The majority of students will be placed in the high priority schools of Oxnard Elementary and Oxnard Union High School Districts, as well as other diverse districts throughout the county. The University Preparatory School (currenly K-5, soon to be K-8), with a very diversified student population, is the lab school for CSUCI and will provide many internship opportunities. Some of the collaborating teachers were the participants of Leadership Institute of CSU Channel Island/California Lutheran University California Mathematics Project (2002-present), other are recommended by the school districts.

6.4 Prospective teachers will have opportunities to reflect on and analyze their early field experiences in relation to course content. These opportunities may include field experience journals, portfolios, and discussions in the subject matter courses, among others.

All the students in early field experience (MATH 492) are required to keep journals of their experiences, and prepare the content-based presentation for the Senior Colloquium (MATH 499), the cap stone course for mathematics majors. The Colloquium is the discussion-based class, where both faculty and students discuss and evaluate the projects.

6.5 Each prospective teacher is primarily responsible for documenting early field experiences. Documentation is reviewed as part of the program requirements.

All the students in early field experience (MATH 492) are required to keep journals of their experiences. The journals are evaluated by the faculty advisor, and a report is written by the student in preparation for the Senior Colloquium (MATH 499) presentation (that could be done in the following semester).

The CSUCI Credential Office provides formal forms for early field experiences evaluations by the school advisors and the faculty advisor. These forms are an official part of the student application to the Credential Program.

**Standard 7: Assessment of Subject Matter Competence**

The program uses formative and summative multiple measures to assess the subject matter competence of each candidate. The scope and content of each candidate's assessment is consistent with the content of the subject matter requirements of the program and with institutional standards for program completion.

Required Elements**:**

7.1 Assessment within the program includes multiple measures such as student performances, presentations, research projects, portfolios, field experience journals, observations, and interviews, as well as oral and written examinations based on criteria established by the institution.

Assessment within the Mathematics program includes multiple measures. While almost all of the mathematics courses include content-based, problem solving oral or written examinations, many use other modes of assessment such as homework, team work presentations (MATH 499), projects (MATH 318), on-line work, electronic portfolios (MATH 331), field experience journals (MATH 492), and critical essays (MATH 331, 230). In most of the mathematics classes the mastery of the subject matter is evaluated by homework problems, on-line work, projects, electronic portfolios, tests, quizzes, and exams. The evaluations tools are compatible across the program, and evaluation of students following the Education Emphasis is compatible with evaluation of other math majors. All mathematics seniors are required to present their independent work in a written and oral form at Senior Colloquium (MATH 499). The Colloquium will be vital to polishing the student teacher's presentation skills. The written, oral, graphic and symbolic representations will go a long way toward enhancing their classroom communication skills.

7.2 The scope and content of each assessment is congruent with the specifications for the subject matter knowledge and competence as indicated in the content domains of the Commission-adopted subject matter requirement.

Math majors taking courses at CSUCI Mathematics Program follow a specific order (see the Mathematics BS Degree Information Chart, Appendix A for details) and assessment of the subject mater knowledge and competence after each course is consistent with the content domains of the Commission-adopted subject matter requirement. Please refer to the Matrix 1 on page 3 for specific standards covered in each course, and course syllabi in the appendix A for assessment procedures and content. Through presentation, assessment, and reflection oriented classes such as MATH 318, 492 and 499 the multiple measures and alternative assessments are built into the program for the student teachers. They experience using alternative assessments in their classroom settings, so they can use them in the future in their own classrooms.

7.3 End-of-program summative assessment of subject matter competence includes a defined process that incorporates multiple measures for evaluation of performance.

Each student is required to complete all courses in the program with a grade C or higher. The university policy allows the repetition of courses for grade improvement. Assessment of the subject matter in each course incorporates assessment measures appropriate to the course: presentations, research projects, portfolios, field experience journals, observations, oral and written examinations. Each course syllabus follows a template developed by the mathematics faculty and approved by the university curriculum committee that specifies the course content, objectives, assessment procedures, technology expectations, etc. Please see Matrix 2 and examples of the syllabi in the appendix A. The students are informed of the evaluation procedures, course objectives, and course expectations during the first class in each course. In a semester before graduation semester, student's progress is evaluated by the Advising Center, and "the graduation check" is conducted. The chair of the program (or designee) reviews and signs the final graduation form, and conducts an exit interview with the student that includes the summative assessment of subject matter competence. Students are required to attend the Senior Colloquium (MATH 499) in their year of graduation, where their overall mathematics competence is evaluated, and their (research or mathematics education based) projects are presented in a written and oral form.

7.4 Assessment scope, process, and criteria are clearly delineated and made available to students when they begin the program.

The students pursuing the BS in Mathematics degree at CSUCI are informed by the program description in the university catalog about the program requirements, proposed course of study, advising within the major and outside of the major, the teacher credential advising, assessment process, and GPA expectancy (at least C in each of the math courses is required to stay in the major, and at least 2.75 overall GPA is required to enter the Single Subject Credential Program in Mathematics). The catalog description of each course is provided. Additionally, students are given the course chart (see the Appendix A, CSUCI MATHEMATICS B.S. DEGREE INFORMATION) showing the course flow and prerequisites. Examples of course syllabi, that include detailed assessment scope, process, and evaluation criteria, are available at the program office.

7.5 Program faculty regularly evaluates the quality, fairness, and effectiveness of the assessment process, including its consistency with program requirements.

Faculty will meet regularly, formally and informally, to assess programs. This approach will provide an opportunity for them to give feedback regarding their experiences and to make suggestions for possible changes or modifications to the program. Faculty discusses program issues and explores changes or modifications, which enhance the relevance of the curriculum. The program faculty communicates with adjunct faculty for the same purpose. Discussions also focus on program modifications that reflect CCTC standards and an optimum integration and coordination of assignments and readings across courses.

The development of syllabi templates for each course gives the curriculum the consistency of a well-planned and executed process. Each curricular area has a syllabus template that includes specific student learning outcomes (see examples in Appendix B) Content faculty meets regularly to examine consistency and articulation across the various courses.

7.6 The institution that sponsors the program determines, establishes, and implements a standard of minimum scholarship (such as overall GPA, minimum course grade, or other assessments) of program completion for prospective single subject teachers.

The CSUCI Channel Islands Single Subject Credential program requires of all their applicants an overall GPA of at least 2.65 with no course grade lower than a C minus. However, the Mathematics program expects the students to maintain their GPA at an average of at least 2.65, with the minimum grade of C in all mathematics courses. The early field experience in mathematics is required.

**Standard 8: Advisement and Support**

The subject matter program includes a system for identifying, advising, and retaining prospective Single Subject teachers. This system will comprehensively address the distinct needs and interests of a range of prospective teachers, including resident prospective students, early deciders entering blended programs, groups underrepresented among current teachers, prospective teachers who transfer to the institution, and prospective teachers in career transition.

Required Elements:

8.1 The institution will develop and implement processes for identifying prospective Single Subject teachers and advising them about all program requirements and career options.

Mathematics Majors have a faculty member serving as an advisor, who supervises his/her Subject Matter competency and progress towards degree. There is also an Advising Center on campus that provides general advising for various majors and general education advising. As each candidate progresses through the program, s/he is encouraged to interact with a credential analyst, the Single Subject program coordinator, and other advisors, all of whom are knowledgeable about program requirements, deadlines, and procedures. When appropriate, small portions of class time are used to update and remind students about upcoming deadlines, requirements, and other important program matters.

Students are frequently informed by faculty and administration of the importance of being in contact with the credential analyst. Office staff and program administrators advise students with regard to fees and financial aid. Students are directed to the Office of Financial Aid as part of their initial interview with the Teacher Education Program Admissions Committee.

8.2 Advisement services will provide prospective teachers with information about their academic progress, including transfer agreements and alternative paths to a teaching credential, and describe the specific qualifications needed for each type of credential, including the teaching assignments it authorizes.

Mathematics Majors have a faculty member serving as an advisor, who supervises his/her Subject Matter competency and academic progress and informs the students of alternative paths to a teaching credential. The program has various credit transfer agreements with local colleges, other CSU and UC campuses, and CAN articulation of various courses (see Appendix A). The Advising Center on campus advises students on various transfer options and substitutions, and the content departments reviews and approves them. Each candidate is encouraged to interact with his/her advisor, a credential analyst, and the Single Subject program coordinator, about program requirements, deadlines, and procedures.

8.3 The subject matter program facilitates the transfer of prospective teachers between post-secondary institutions, including community colleges, through effective outreach and advising, and the articulation of courses and requirements. The program sponsor works

cooperatively with community colleges to ensure that subject matter coursework at feeder campuses is aligned with the relevant portions of the *State-adopted Academic Content Standards for K-12 Students in California Public Schools*.

Mathematics Program cooperates with the university articulation officer and has various credit transfer agreements with local colleges, other CSU and UC campuses, and CAN articulation of various courses (see Appendix A). The Mathematics faculty from CSUCI, periodically meets with the faculty and advisors from local feeder campuses to ensure that the subject matter coursework is transferable and aligned with the relevant portions of the *State-adopted Academic Content Standards for K-12 Students in California Public Schools* and to discuss (among other things) the alternative paths to a teaching credential. The subject matter program in mathematics will facilitate the transfer of prospective teachers from other post-secondary institutions and other programs, by offering Subject Matter Clearance courses for Credential Candidates.

8.4 The institution establishes clear and reasonable criteria and allocates sufficient time and personnel resources to enable qualified personnel to evaluate prospective teachers' previous coursework and/or fieldwork for meeting subject matter requirements.

CSUCI is expected to allocate release time for the mathematics faculty (advisor/coordinator) qualified to evaluate prospective teachers' previous coursework and/or fieldwork for meeting subject matter requirements. The subject matter program in mathematics will facilitate the transfer of prospective teachers from other programs and institutions by offering Subject Matter Clearance for Credential Candidates (that may include additional undergraduate courses in mathematics, depending on the candidates transcripts and experiences).

**Standard 9: Program Review and Evaluation**

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| The institution implements a comprehensive, ongoing system for periodic review of and improvement to the subject matter program. The ongoing system of review and improvement involves university faculty, community college faculty, student candidates, and appropriate public schools personnel involved in beginning teacher preparation and induction. Periodic reviews shall be conducted at intervals not exceeding 5 years. |

Mathematics program was reviewed recently and praised by the CSU external reviewers. The university is preparing for the second stage of the WASC evaluation for accreditation. The Mathematics Department assesses teaching effectiveness and content competency systematically and conducts departmental on-line surveys of students and faculty.

**By Faculty**

Faculty will meet regularly, formally and informally, to assess programs. This approach will provide an opportunity for them to give feedback regarding their experiences and to make suggestions for possible changes or modifications to the program. Faculty discusses program issues and explores changes or modifications, which enhance the relevance of the curriculum. The program faculty communicates with adjunct faculty for the same purpose. Discussions also focus on program modifications that reflect CCTC standards and an optimum integration and coordination of assignments and readings across courses. The development of syllabi templates for each course gives the curriculum and the assessment process the consistency.

**By Graduates and Employers**

We are developing a variety of approaches to evaluation by our program graduates and employers. Our intent is to work in consultation with our area districts to conduct follow-up surveys of graduates and employers. To that end, the faculty meets regularly with members of the K–12 community to gain their perspective and insights into the implementation of our program. For example, cooperating teachers provide ongoing input into the implementation of the fieldwork/internship component. We envision that these evaluations will be done regularly and consistently to guide the implementation and long-range program development and revision. We will participate in the process developed by the CSU Chancellor's Office that entails an annual survey of all first-year Credential program graduates and their principals. This program evaluation plan will provide a comprehensive, systematic, and continuous evaluation of all our teacher education programs, not only in mathematics. This program evaluation will be implemented with our first graduates in spring 2004.

Each university supervisor and mentor teacher will complete evaluations of candidates' fieldwork experiences. They will provide feedback regarding the assessment of each candidate's competence and will write a reflection on the candidate's preparation to perform successfully. Results of these evaluations will be compiled and shared with the program faculty, giving valuable information as program changes and modifications are considered. Additionally, they will provide feedback on the various components of the programs.

**By the Students**

Students complete program evaluation forms at the completion of the program. The results of the program evaluations are compiled and a summary is given to the instructors and faculty. This information is used in making course and program modifications on a continuous basis. In keeping with the University's assessment priorities, these evaluations focus on the learning outcomes expected for each course or field experience. Additionally, students provide evaluation input into each course they complete through university-wide course evaluation procedures. The course evaluation solicits input from the students on the utility and effectiveness of a given course and provides additional feedback specific to the instructor's teaching.

An additional mechanism for continuous feedback from students entering the Single Subject Matter Credential Program is the Cohort Council, a representative group of credential candidates (one from each cohort) who will meet regularly to discuss common issues and concerns. Initially, one faculty member will serve as an advisor for the Cohort Council, and information from Cohort Council meetings will be communicated to the faculty and administration, the faculty advisors, and participating students.

**Program Development and Revision**

Program development and revision will be ongoing at CSUCI. Program administrators and faculty members will utilize follow-up studies, final assessment and course evaluations, assessments from field experience site supervisors, formal and informal discussions with students and faculty, current research and readings, and feedback from the community for input and direction regarding program development. Faculty meeting minutes will provide evidence of continuous program and curriculum review and modification.

The university faculty began the process of identifying outcomes for CSUCI graduates by involving the key members of the educational community in Ventura and Southern Santa Barbara counties in a strategic planning process in November of 2001. The overall desired characteristics, knowledge, skills, and dispositions of graduates were identified. Further, the group articulated the ways that they saw the University and educational community working together to produce skillful educators. These form the foundation of the educational programs.

Required Elements:

9.1 Each periodic review includes an examination of program goals, design, curriculum, requirements, student's success, technology uses, advising services, assessment procedures, and program outcomes for prospective teachers.

Mathematics program was reviewed recently and praised by the CSU external reviewers. The university is preparing for the second stage of the WASC evaluation for accreditation. Also, each program is scheduled for the university review every 5 years. The Mathematics Department assesses teaching effectiveness and content competency systematically, and conducts

departmental on-line surveys of students and faculty. The examination includes program goals, design, curriculum, requirements, student's success, technology uses, advising services, assessment procedures, and program outcomes for prospective teachers. The program faculty communicates with adjunct faculty for the same purpose. Discussions also focus on program modifications that reflect CCTC standards and an optimum integration and coordination of assignments and readings across courses.

9.2 Each program review examines the quality and effectiveness of collaborative partnerships with secondary schools and community colleges.

Collaboration with K-12 educators is fundamental to the mission of CSUCI. This commitment is evident in our initial and ongoing establishment of several alliances. Since the adoption of the new standards, a planning group composed of CSUCI faculty, administrators, CSU Northridge Off-campus Center, and representatives of the Ventura County Superintendent of Schools Teacher Support Programs (encompassing the Learning to Teach Continuum) has been meeting regularly. The original planning group discussed: the need for various credentials in the region, who should be involved in planning the teacher preparation programs, and how the programs should proceed. The university faculty involves the key members of the educational community in Ventura and Southern Santa Barbara counties in evaluating the quality and effectiveness of collaborative partnerships.

The mathematics and education faculty has periodic meetings with the community college's mathematics faculty and advisors, school districts, and participating school teachers to collect their input and ideas, and resolve issues of the partnerships. The following statements express the suggestion from recent meetings:

- Expose undergraduates early and often to classrooms, particularly those with a diversity of student populations
- Support more personal contract and collaboration with veteran teachers (not only one master teacher)
- Develop a good mentoring system early-on and with all stakeholders that demonstrates that schools and university are partners in a reciprocal relationship
- Develop learning communities with a variety of ages, types of assignments, and grade levels, to support and give feedback to each other.
- Base the appropriate classroom and field work on experiential learning with excellent modeling
- Identify model programs/classrooms

The information provided by the field experience supervisors, schools, and involved districts is collected for each student and evaluated frequently. We plan to follow our mathematics graduates through their credential programs and into their career with evaluations of program quality and collaboration effectiveness from their perspective.

9.3 The program uses appropriate methods to collect data to assess the subject matter program's strengths, weaknesses, and areas that need improvement. Participants in the

review include faculty members, current students, recent graduates, education faculty, employers, and appropriate community college and public school personnel.

The mathematics program collects data through on-line surveys, paper surveys, student evaluations, faculty suggestions, community suggestions, interviews, student follow ups, faculty, etc. The issues include the assessment of the subject matter program's strengths, weaknesses, and areas of improvement. The results are presented to the mathematics faculty and larger university faculty and administration as reports on data with areas of concern underlined. Since we are a start-up institution, we are just going through the first phase of data collection and analysis which are currently being reviewed by the faculty, administration, and WASC committee. Further review panels will include mathematics faculty, current students, recent graduates, education faculty, employers, and appropriate community college and public school personnel.

9.4 Program improvements are based on the results of periodic reviews, the inclusion and implications of new knowledge about the subject(s) of study, the identified needs of program students and school districts in the region, and curriculum policies of the State of California.

The mathematics faculty as well as university administration plans to base mathematics program improvements on the results of periodic reviews, the inclusion and implications of new knowledge in mathematics and mathematics education, the identified needs of program students and school districts in the region, and curriculum policies of the State of California. Even though the university has admitted students for only two years, we have a good track record of cooperation with educational stake holders in the region and the state, and our curriculum is modern and follows the guidelines of Single Subject Credential in Mathematics and *State-adopted Academic Content Standards for K-12 Students in California Public Schools*.

**Standard 10: Coordination**

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| One or more faculty responsible for program planning, implementation, and review coordinate the Single Subject Matter Preparation Program. The program sponsor allocates resources to support effective coordination and implementation of all aspects of the program. The coordinator(s) foster and facilitate ongoing collaboration among academic program faculty, local school personnel, local community colleges, and the professional education faculty. |

Required Elements:

10.1 A program coordinator will be designated from among the academic program faculty.

The mathematics faculty advisor/coordinator for Credential Candidates in Mathematics is expected to receive one course release time per semester. The advisor duties will involve student advising for secondary mathematics teaching, transcript evaluation, and course advisement (Subject Matter Clearance) for credential candidates, Foundational Mathematics advisement, and early field experience coordination and program coordination with education faculty, other academic advisors, and credential advisors.

10.2 The program coordinator provides opportunities for collaboration by faculty, students, and appropriate public school personnel in the design and development of and revisions to the program, and communicates program goals to the campus community, other academic partners, school districts, and the public.

The mathematics faculty advisor/coordinator will provide a broad forum for communication and collaboration by faculty, students, and appropriate public school personnel through meetings, on-line communications, various reviews, surveys, suggestions, and publications. The periodic meetings for mathematics and credential faculty will include personnel supervising early field experiences and other involved educators. The review process, the design and development of, and revisions to the program will include the campus community, other academic partners, school districts, and the public.

10.3 The institution allocates sufficient time and resources for faculty coordination and staff support for development, implementation, and revision of all aspects of the program.

The mathematics faculty advisor/coordinator for Credential Candidates in Mathematics is expected to receive one course release time per semester and necessary staff support is planned. The advisor duties will involve student advising; faculty coordination; program development, implementation, and revision; and early field experience coordination. Additional resources will be assigned when requested.

10.4 The program provides opportunities for collaboration on curriculum development among program faculty.

The mathematics program will provide a broad forum for communication, collaboration, and curriculum development by faculty in mathematics and Credential Program, through meetings, on-line communications, various reviews, surveys, suggestions, and publications. Meetings for mathematics and credential faculty will include personnel supervising early field experiences and other involved educators.

10.5 University and program faculty cooperate with community colleges to coordinate courses and articulate course requirements for prospective teachers to facilitate transfer to a baccalaureate degree-granting institution.

The CSUCI Mathematics Program has various credit transfer agreements with local colleges, other CSU and UC campuses, and CAN articulation of various courses (see Appendix A). The mathematics faculty meets periodically with the faculty and advisors from the local community colleges to coordinate courses and articulate appropriate courses. The university Articulation Officer communicates with postsecondary institutions and coordinates articulation process. The Advising Center on campus advises students on various transfer options and substitutions, and the content department reviews and approves them. Each candidate is encouraged to interact with his/her advisor, a credential analyst, and the Single Subject program coordinator about program requirements, deadlines, and procedures. The subject matter program in mathematics will facilitate the transfer of prospective teachers from other post-secondary institutions and other programs by offering Subject Matter Clearance courses for Credential Candidates.

# Mathematics Subject Matter Program Standards

**Standard 11: Required Subjects of Study**

In the program each prospective teacher studies and learns advanced mathematics that incorporates the Mathematics Content Standards for California Public Schools: Kindergarten Through Grade Twelve (1997) and the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999). The curriculum of the program addresses the *Subject Matter Requirements* and standards of program quality as set forth in this document.

Required Elements

11.1* Required coursework includes the following major subject areas of study: algebra, geometry, number theory, calculus, history of mathematics, and statistics and probability. This coursework also incorporates the content of the student academic content standards from an advanced viewpoint (see *Attachment to Standard 11: Required Subjects of Study* page 18). Furthermore, infused in required coursework are connections to the middle school and high school curriculum.

The BS Mathematics Program at CSUCI requires all students to take 11 common courses in mathematics (MATH 150, 151, 230, 140, 250, 300, 331, 350, 351, 352, and 452), that include the calculus-differential equations-real analysis sequence, logic-discrete mathematics sequence, linear algebra, complex analysis, and history of mathematics courses. All students are required to take a senior colloquium sequence that is considered a capstone course. By the end of the sophomore year students choose an emphasis. Students planning to teach may choose the Education Emphasis that includes a geometry-based MATH 318 (Math for Secondary School Teachers), MATH 393 (Abstract Algebra), and EDUC 512. These courses plus the MATH 492 Internship (an early field experience) constitute the Core Mathematics program for future Single Subject Credentials in Mathematics candidates. The required coursework of studies includes all domains and standards for mathematics: algebra, geometry, number theory, calculus, history of mathematics, and statistics and probability. The table on the next page displays the courses that meet the specific content requirements. Note that MATH 318 includes a service-learning project that involves teaching/tutoring mathematics (several hours per semester) and the MATH 492 Internship includes supervised teaching of mathematics content in local schools. Students are also required to take *Breadth and Perspective* courses in computer science, physics, interdisciplinary applications, and additional math electives. Also, please see the Matrix 1 on page 3.

MATRIX 2

11.2 Required coursework exposes underlying mathematical reasoning, explores connections among the branches of mathematics, and provides opportunities for problem solving and mathematical communication.

Required courses start with a symbolic logic course that stresses critical thinking, precision of expression, definitions, proofs, logical expressions, and tautologies. All courses expose underlying mathematical reasoning and include argument and simple proof writing, and provide opportunities for problem solving and mathematical communication through team work, projects, homework assignments, quizzes, exams, presentations, on-line research, etc. Note that MATH 331 requires essays on mathematics development and problem solving in historical context, as well as electronic portfolio management. Many courses, especially interdisciplinary ones and electives, explore connections among the various branches of mathematics and other fields – for example MATH 320 Math and Art; MATH 331 History of Mathematics; MATH 452 Bioinformatics; MATH 351 Real Analysis; MATH 344 Analysis of Algorithms; MATH 430 Research design and Data Analysis; and MATH 484 Number Theory and Cryptography.

11.3 Required courses are applicable to the requirements for a major in mathematics. Remedial classes and other studies normally completed in K-12 schools are not counted in satisfaction of the required subjects of study.

All courses required by Single Subject in Mathematics Candidates are a part of our regular BS program in Mathematics and are either required by all students in the program or are elective courses. No remedial classes and other studies normally completed in K-12 schools are counted in satisfaction of the required subjects of study.

11.4 The institution that sponsors the program determines, establishes and implements a standard of minimum scholarship for coursework in the program.

The students enrolled in the BS in Mathematics program are required to be in good university standing, to maintain the GPA of 2.65 in all CSUCI courses taken, and to receive grade of at least C in all required mathematics courses.

11.5 Required coursework includes work in computer science and/or related mathematics such as: 1) discrete structures (sets, logic, relations, and functions) and their application in the design of data structures and programming; 2) design and analysis of algorithms including the use of recursion and combinations; and 3) use of the computer applications and other technologies to solve problems.

All students in the BS in Mathematics program at CSUCI are required to take a discrete mathematics course, two courses in computer science (at least one programming course), two

calculus-based physics courses, an additional interdisciplinary course (university-wide requirement), and additional math electives. Please see the BS Degree Information Chart in the appendix for details.

**Standard 12: Problem Solving**

In the program prospective teachers of mathematics develop effective strategies for solving problems both within the discipline of mathematics and in applied settings that include non-routine situations. Problem-solving challenges occur throughout the program of subject matter preparation in mathematics. Through coursework in the program, prospective teachers develop a sense of inquiry and perseverance in solving problems.

Required Elements

In the program, each prospective teacher learns and demonstrates the ability to:

12.1 Place mathematical problems in context and explore their relationship with other problems.

The mathematics faculty has a philosophy of placing the problems in various contexts and analyzing them from different points of view.

The optimization problems are good examples here, as they can be interpreted in various contexts and situations – in physics, economics, biology, chemistry, etc. The underlying functions can be put in families with parameters, and studied using graphic tools or analytical, abstract thinking. Problems in probability and statistics classes are also interpreted in various contexts and, interestingly, the same mathematical results may give different interpretations depending on the situation. For instance, a 5% error is usually not acceptable in pharmacology, but is considered quite reasonable in population studies. Consult syllabi in Appendix B for more examples.

12.2 Solve mathematical problems in more than one way when possible.

Whenever appropriate, students are required to solve problems in many different ways. This approach is especially stressed in the calculus sequence, which is considered an introduction to higher mathematics. Often students are asked to solve a problem, for example calculating an area analytically (by solving an equation), graphically (by analyzing a graph), geometrically (by elementary geometry), or numerically (by estimating a solution). Different ways of defining functions are used –verbal descriptions, tables, graphs, and formulas. Often projects are assigned where students explore the situation in groups and provide various solutions using different tools and approaches (please see the exemplary syllabi). Some problems are discussed in various courses from a different point of view (i.e., definitions and properties of number systems are discussed in logic, calculus, real analysis, abstract algebra, complex analysis—functions and their properties are discussed in logic, calculus, differential equations, real analysis, and complex analysis).

12.3 Generalize mathematical problems in more than one way when possible.

Generalization of mathematical problems is included in most of the courses, especially the upper division ones. For example: properties of various number systems in the Abstract Algebra course (MATH 393) lead to the studies of groups, rings, and fields in connection with the study of geometric transformations in MATH 318 (geometry-based course) and on to the study of Cyclic and Dihedral groups in MATH 320 (Mathematics and Fine Arts). Another example of generalization used across the curriculum is the various interpretations of complex numbers that appear in calculus as pairs (a,b), in differential equations as $cos\ x+i\ sin\ x$ , in geometry as points on the plane, in linear and abstract algebra as matrices, and in complex analysis as $e^{it}$ .

12.4 Use appropriate technologies to conduct investigations and solve problems.

Various technologies are used across the undergraduate curriculum to conduct investigations and solve problems. Calculus classes use various 2D and 3D graphic tools including hand-held devices, software solutions, and on-line graphic programs. MathLab, Maple, and various compatible freeware software are used for calculations. Statistics classes are SPSS based, but we are planning to provide SAS software for upper division students. Geometry classes use Geometry Sketch pad-compatible software, as well as freeware symmetry generating software, tiling software, and graphic programs. Computer Science classes and Numerical Analysis classes include basic programming in various languages, hence software development tools and compilers are used. All students are expected to use basic text editors (MS Word, Simple text), Excel, and presentation tools (such as Power Point).

**Standard 13: Mathematics as Communication**

In the program prospective teachers learn to clearly and coherently communicate their thinking to others using appropriate language, symbols, and technologies. Prospective teachers develop communication skills in conjunction with mathematical literacy in each major component of a subject matter program.

Required Elements

In the program each prospective teacher learns and demonstrates the ability to:

13.1 Articulate mathematical ideas verbally and in writing, using appropriate terminology.

Students entering the BS program in Mathematics at CSUCI start with a symbolic logic course which stresses critical thinking, precision of expression, definitions, proofs, logical expressions, and tautologies. That is followed by discrete mathematics course, where counting arguments and mathematical justifications are required. All courses expose underlying mathematical reasoning and include precise arguments and simple proof writing, provide opportunities for written and oral mathematical communication through team work, projects, homework assignments, quizzes, exams, presentations, on-line research, etc. Upper division courses such as Abstract Analysis, Complex Analysis, and Abstract Algebra include mathematical definition, proof writing of theorems, and logical arguments. In MATH 492 students keep a journal of their field experiences in mathematics. MATH 499 requires students to prepare a written report and oral presentation of their research or internship projects. Note that MATH 331 requires essays on mathematics development and problem solving in historical context, as well as electronic portfolio management.

13.2 Where appropriate present mathematical explanations suitable to a variety of grade levels.

In MATH 318 future teachers conduct a service learning project in geometry tutoring students of various ages with different backgrounds from local schools (including CSUCI sponsored the University Preparatory School K-8 and the high school students from California Conservation Corps), local community colleges, and the university. MATH 492 Internship class places students in the appropriate 6-12 grade in a local school where, supervised by an in-service teacher as part of their assignments, they teach mathematics content to children with various backgrounds. Education Emphasis students take EDUC 512 course that introduces them to the various issues if diversity in the typical California classroom.

13.3 Present mathematical information in various forms, including but not limited to models, charts, graphs, tables, figures, and equations.

Starting from introductory courses students are required to present their mathematical information in various forms. Logic and Discrete Mathematics courses stress verbal descriptions,

logical models, charts, graphs, and logical formulas. The Calculus sequence includes mathematical models, charts, function graphs, tables, and equations. Linear Algebra and Abstract Algebra courses build abstract models using n-dimensional vectors, matrices, graphs, tables, and matrix equations. Complex Analysis stresses geometric interpretation of numbers and representations of functions as convergent power series. In the geometry-based courses (MATH 318 and MATH320) students mathematically construct objects (with a straight edge and compass), draw 2D figures and lines, build 3D models and geometric objects (Platonic solids, Mobius strip), draw graphs, study relations and deduce geometric equations (Euler's formula) and identities (Pythagoras theorem).

History of Mathematics course includes an electronic portfolio, web-based instructions, critical essays, and provides historical context for development of mathematics and our current formalism.

13.4 Analyze and evaluate the mathematical thinking and strategies of others.

In MATH 492 Internship (early field experience) students keep a journal of their reflections and observations. They evaluate the mathematical thinking of the supervising teacher, students, and his/her own. In MATH 499 senior colloquium students analyze and evaluate oral presentations of various speakers, including the projects of their colleagues. In MATH 331 they analyze historical issues connected to problem solving and mathematics development. In MATH 318 they evaluate their students and colleagues during the Service Learning Project. In various classes across the undergraduate curriculum they have a chance to work in teams and evaluate mathematical thinking and strategies of others through classroom or team discussions.

13.5 Use clarifying and extending questions to learn and to communicate mathematical ideas.

Students are encouraged to ask questions in all classes. Discussions of various ideas on the class forum is often conducted and provoked. Homework assignments and quizzes are discussed and students have a chance to communicate their solution to each other. Teamwork in various classes gives a chance to talk mathematics to their colleagues. In MATH 499 during student presentations clarifying and extending questions are expected to be asked and answered.

13.6 Use appropriate technologies to present mathematical ideas and concepts.

Various technologies are used across our undergraduate curriculum. Calculus classes use various 2D and 3D graphics tools for graph presentations. MathLab, Maple, and various compatible freeware software are used for calculations. Statistic classes are SPSS based, but we are planning to provide SAS software for upper division students. Geometry classes use Geometry Sketch Pad compatible software, freeware, 2D and 3D symmetry software, tiling software, and graphic programs. Computer Science classes and Numerical Analysis classes include basic programming in various languages, hence, software development tools and compilers are used. All students are expected to efficiently use various text editors (MS Word, Simple text), Excel, and presentation tools (such as Power Point).

**Standard 14: Reasoning**

In the program prospective teachers of mathematics learn to understand that reasoning is fundamental to knowing and doing mathematics. Reasoning and proofing accompany all mathematical activities in the program.

Required Elements

In the program each prospective teacher learns and demonstrates the ability to:

14.1 Formulate and test conjectures using inductive reasoning, construct counter-examples, make valid deductive arguments, and judge the validity of mathematical arguments in each content domain of the subject matter requirements.

Our undergraduate students in Mathematics start with a symbolic logic course which stresses critical thinking, precision of expression, definitions, proofs, logical expressions, and tautologies. In this context they use inductive reasoning, construct counter-examples, make valid deductive arguments, and judge the validity of mathematical arguments. All other courses expose underlying mathematical reasoning and include mathematical arguments and simple proof writing, including inductive reasoning, counter-examples, and deductive arguments. MATH 393 Abstract Algebra, MATH 240 Linear Algebra, and MATH 300 Discrete Math cover reasoning and arguing in the algebraic context; MATH 318 and MATH 320 Math and Art, cover geometric reasoning; MATH 484 and 393 deal with number theoretical approaches; MATH 352 Probability and Statistics includes probabilistic, statistical arguments; and the Calculus-Differential Equations sequence and MATH 351 Real Analysis cover trigonometric, infinitesimal, and functional arguments, including sequences and series and their applications. MATH 331 History of Mathematics teaches historical context approach to formulation of selected conjectures and theories, mathematical techniques, and reasoning evaluations, validation of arguments. All courses have critical thinking and inductive and deductive reasoning approach. See the Matrix 1 on page 2, and the Matrix 2 in the Appendix A.

14.2 Present informal and formal proofs in oral and written formats in each content domain of the subject matter requirements.

In MATH 230 Logic course students learn about mathematical formalism, definition, quantifiers, theorems, and proofs.

They are expected to carry this knowledge to their other courses to expose underlying mathematical reasoning and include mathematical arguments and simple proof writing, including inductive reasoning, counter-examples, deductive arguments, informal proofs. MATH 393 Abstract Algebra, MATH 240 Linear Algebra and MATH 300 Discrete Math include oral and written algebraic proofs; MATH 318 and MATH 320 Math and Art, cover geometric proofs; MATH 484 and 393 deal with number theoretical formalism, MATH 352 Probability and Statistics includes probabilistic and statistical arguments; the Calculus-Differential Equations sequence and MATH 351 Real Analysis cover trigonometric, and calculus-based proofs,

including sequences and series and their applications. MATH 331 History of Mathematics, includes selected theories and important proofs in historical context. All courses include appropriate mathematical language, and informal and formal arguments.

**Standard 15: Mathematical Connections**

In the program prospective teachers of mathematics develop a view of mathematics as an integrated whole, seeing connections across different mathematical content areas. Relationships among mathematical subjects and applications are a consistent theme of the subject matter program's curriculum.

Required Elements

In the program each prospective teacher learns and demonstrates the ability to:

15.1 Illustrate, when possible, abstract mathematical concepts using applications.

Interdisciplinary connections are stressed in the CSUCI mission. All students are required to take 3 interdisciplinary courses, including one outside of their discipline. MATH 331 History of Mathematics course is a required interdisciplinary course for our Mathematics majors. Several Mathematic electives (MATH 344 Analysis of Algorithms, MATH 320 Mathematics and Fine Arts, MATH 484 Algebraic Geometry and Coding Theory, MATH 452 Bioinformatics, and others) have interdisciplinary flavor, providing students many examples and appropriate applications of mathematical concepts. All math students take Computer Science courses, calculus-based physics courses, and a life science course, and other general education courses (such as Economics and Psychology), where they are presented with mathematical concepts in other fields.

15.2 Investigate ways mathematical topics are inter-related.

The content topics in our mathematics program show up in various contexts, in different courses, and are analyzed from different points of view. Students will have a chance to observe and discuss connections between various topics and learn how to translate a problem from one context to another. Often projects are assigned where students explore a mathematical concept and provide various solutions using tools and approaches from different areas of mathematics. For example: functions and their properties are included in various courses, and they unify the mathematical curriculum; number systems are discussed in logic, calculus, real analysis, abstract algebra, complex analysis; functions and their properties, in logic, calculus, differential equations, real analysis, complex analysis. Students are encouraged to provide and discuss their original solutions to various problems, and to investigate ways the different solutions inter-relate. Additionally, required physics and interdisciplinary courses provide understanding of mathematics application in various fields.

15.3 Apply mathematical thinking and modeling to solve problems that arise in other disciplines.

All CSUCI students are required to take 3 interdisciplinary courses, including one outside of their discipline. Several Mathematic electives (MATH 344 Analysis of Algorithms, MATH 320 Mathematics and Fine Arts, MATH 484 Algebraic Geometry and Coding Theory, MATH 452

Bioinformatics, and others) have interdisciplinary flavor, and provide students chances to use mathematical modeling and problem solving in other disciplines. All math students take computer science courses that require implementing algorithms (logic and discrete math applications). Required calculus-based physics courses provide a vast set of mathematical modeling and problem solving opportunities. Selected general education courses such as economics and (experimental) psychology extensively use mathematical modeling for decision making and problem solving in their fields (for example profit optimization and hypothesis testing).

15.4 Recognize how a given mathematical model can represent a variety of situations.

Students will be provided with many instances where a given mathematical model can represent a variety of situations. In calculus a function can represent a physical, economical, or psychological model. In probability an abstract sample could represent biological, political, or consumer population. Complex numbers can appear in calculus as pairs (a,b), in differential equations as expressions $\cos x + i \sin x$ , in geometry as points on the plane, in linear algebra or abstract algebra as matrices, in complex analysis as $e^{it}$ , etc. Students are encouraged to build their own interpretations to given models.

15.5 Create a variety of models to represent a single situation.

Undergraduate mathematics curriculum will provide Single Subject Credential Students with a variety of ways to interpret given situations and to build a variety of valid models. From combinatorial approaches in Discrete Mathematics (MATH 300) to functional approaches in the Calculus sequence or to abstract approaches in Abstract Algebra. The students will be given a chance to explore and develop their own models and solutions for various problems. Teamwork is assigned in various courses (MATH 318, calculus sequence) and discussion of various models is encouraged.

15.6 Understand the interconnectedness of topics in mathematics from an historical perspective.

MATH 331 History of Mathematics course provides the historical perspective on mathematics development, breakthroughs, and interconnectedness of topics. The course requires several reflective essays on various mathematical concepts and problem solving improvements. One of the first assignments asks students to identify several great progress-related ideas from social, technological, and mathematical points of view. To understand connections of mathematics in a historical context they compare chronology lines of technological, social, and mathematical development. The interdependence and interconnectedness of specific problems and ideas in historical context is discussed and exposed.

**Standard 16: Delivery of Instruction**

In the program faculty uses multiple instructional strategies, activities and materials that are appropriate for effective mathematics instruction.

Required Elements

Coursework in the program:

16.1 Is taught in a way that fosters conceptual understanding as well as procedural knowledge.

Mathematics program at CSUCI has a very rigorous, but intellectually stimulating curriculum. From day one students are expected to follow mathematical formalism and precision (Logic), but also to build numerous connections and models through Breadth and Perspective Courses, such as Physics and Computer Science, and interdisciplinary courses, such as Mathematics and Fine Arts and History of Mathematics. Not only a high level of mathematical competency is expected from our graduates, but also a depth in understanding of the mathematics teaching profession that is provided by field experiences, in service learning projects, colloquia presentations, team work, and assessment. While procedural knowledge is evaluated by problem solving skill, homework, and testing, the conceptual understanding is fostered by student projects, research, and discussions. See Matrix 2 for an overview, and course syllabi in Appendix B for examples.

16.2 Incorporates a variety of instructional formats including but not limited to direct instruction, collaborative groups, individual exploration, peer instruction, and whole-class discussion led by students.

Mathematics faculty at CSUCI uses multiple instructional strategies, activities, and materials that are appropriate for effective instruction. Even though lecturing is the most popular format, all instructors use other forms of teaching. Whole-class discussions are used in many classes, especially in MATH 499 Senior Colloquium, where students discuss presentations of others, in MATH 331 where historical context for doing mathematics is important, and in MATH 318 Math for Secondary teachers, where service learning projects and various teaching strategies are discussed. Teamwork is used in the calculus sequence classes and in Linear Algebra, especially for technology-based exploration projects. Individual and group projects are assigned in many classes. In MATH 492 Internship, students write their reflections and observations in their journals, while MATH 352 includes project in statistics.

16.3 Provides for learning mathematics in different modalities, e.g., visual, auditory, and kinesthetic.

The faculty uses various modes for presentation: lecturing, discussions, team work, projects, white boards, on-line notes, hand-outs, worksheets, computer software, simulations, manipulatives, and overhead projectors.

16.4 Develops and reinforces mathematical skills and concepts through open-ended activities.

Most of the projects assigned in mathematics classes are of an exploratory nature and students are expected to come up with their own models and solutions. Discussions are always encouraged, and non-standard solutions welcomed. Students in MATH 492 record in their journals their reflections and observations, ideas for improvement, and new teaching strategies. Seniors in MATH 499 present their original results from internship projects. MATH 331 encourages students to express their opinions on the development of mathematics through their essays. MATH 320 Math and Art allows students to express their mathematical visions through the creation of art.

16.5 Uses a variety of appropriate technologies.

Various technologies are used across our undergraduate curriculum. Calculus classes use various graphic tools for graph presentations, 2D and 3D. For calculations MathLab, Maple, and various compatible freeware software is used. Statistic classes are SPSS based, but we are planning to provide SAS software for upper division students. Geometry classes use Geometry Sketch Pad compatible software, freeware 2D and 3D symmetry software, tiling software, and graphic programs. Computer Science classes and Numerical Analysis classes include basic programming in various languages, hence software development tools and compilers are used. All students are expected to efficiently use various text editors (MS Word, Simple text), Excel, and presentation tools (such as Power Point).

16.6 Includes approaches that are appropriate for use at a variety of grade levels.

Students in MATH 318 and MATH 492 practice their teaching skills at various grade levels. They are supervised by in-service teachers (mentors), who provide pedagogical and methodological advice. Faculty advisors review and discuss journal entries, observations, and reflections, and suggest appropriate content and teaching strategies. MATH 499 presentations of students' results are discussed and analyzed by other seniors.