

## CALIFORNIA STATE UNIVERSITY, EAST BAY

Designation Code: 2005-06 CAPR 19

Date Submitted: May 5, 2006

TO: The Academic Senate

FROM: Committee on Academic Planning & Review (CAPR)

SUBJECT: Five-Year Program Review for the BS, MS and MATH degree programs in Mathematics

PURPOSE: For Approval by the Academic Senate

ACTION

REQUESTED: Acceptance of the Five-Year Program Review of the Mathematics Programs and approval of the continuation of the programs without modification

### BACKGROUND

INFORMATION: The Department of Mathematics and Computer Science offers the following degree programs: B.S. Mathematics, BS. Computer Science, Minors: Mathematics, Computer Science, Software Systems, B.S., Mathematics, M.S., Computer Science, and the M.S. in Telecommunications, Systems, Option in Computer Technologies of Telecommunications. On 12 January 2006 Bill Nico, Professor of Mathematics and Computer Science; Michael Leung, Dean of the College of Science; Ed Keller, Professor of Mathematics and Computer Science; and Eddie Reiter, Chair of Mathematics and Computer Science, met with CAPR to discuss the materials sent to the committee.

Since 2000, the Department has hired four new tenure-track faculty members in Mathematics: Two have been enticed elsewhere. The reasons for these losses do not appear to have been related to dissatisfaction with our department or with the university. Rather, there were issues such as the high cost of housing in the Bay Area and the availability of desirable post-doctoral appointments elsewhere. One of the new faculty lives in the student dorms, enhances the visibility of mathematics and computer science as majors, and adds to campus life. We applaud the diversity in the Mathematics faculty hiring.

Student enrollment in major course is growing. Service courses are expected to decline because of some curricular changes out of the control of the Department of Mathematics and Computer Science, especially in the College of Business.

The mathematics curriculum was revised as a result of the self study in 2000 and the analysis of the curricular changes through its assessment procedures indicates that the inclusion of an introduction of proofs course has increased the retention of students and improved success in the programs. Curricular changes suggested in 2005 may also result in a fourth quarter of calculus as a requirement for MCS majors. CAPR suggests consulting some additional College of Science (COS) major programs to see if there is additional interest (for example, Statistics).

There is an active study program for students in Mathematics including seminars, workshops, colloquia, research projects, support for a variety of activities, advising, and community events. Other programs would do well to foster the kind of retention building activities apparent in mathematics.

The degree programs in Mathematics do not require more than the minimum requirements for graduation at the University. The number of units required for both the BS and MS degrees in Mathematics are aligned with similar degrees throughout the state of California and tend toward the low end of number of units required for graduation.

### CAPR RECOMMENDATION:

CAPR recommends the continuation of the Mathematics Bachelor of Science and Masters of Science degree programs without modification. The next CAPR review will be in 2009-10.

### **Additional Background:**

Overview description of the program: Historically, at most universities, Computer Science began as part of Mathematics; however, CSUEB is the only remaining school in the CSU system where the two have not separated. This has offered unusual opportunities for collaboration, mutual assistance, and innovation.

Also, CSU East Bay has a distinctive student profile. Many students are older, working, and have family responsibilities. Many have begun – or even finished – undergraduate degrees in the near or distant past; they are coming to CSUEB to finish an interrupted education, to learn a new field, or to expand their own horizons.

The Department serves many (and often large) groups of students:

Degree programs:

- B.S. in mathematics
- B.S. in computer science
- Minors: mathematics, computer science, Software Systems
- M.S., mathematics
- M.S., computer science
- M.S. in Telecommunications, Systems, Option in Computer Technologies of Telecommunications

The Master's in Telecommunications Systems is an interdisciplinary degree between the College of Science and the College of Business at CSU East Bay. Students pursuing this degree are required to choose one of two options, Computer Technologies or Telecommunications Management. The option of Computer Technologies is housed in the Department of Math and Computer Science in the College of Science, while the Telecommunications Management option is housed in the Department of Accounting, Computer Information Systems, and Telecommunications in the College of Business. Applicants apply to a degree and an option. Advisors in the Colleges of Science and Business administer each option independently, and each option differs in GPA requirements, prerequisite course requirements, and graduate exam requirements.

Other programs

- Required remediation in mathematics
- Service courses for other majors
- General education mathematics requirements
- C.S. classes for some College of Business CIS students

Each of these sets of students has different requirements; each has seen major changes in the last five years. Meeting the needs of these students has been – and will continue to be – difficult and challenging.

Overview of the documents submitted to CAPR: As required, the report to CAPR included a self study; plan for the degree programs; program assessment plan; outside review; a departmental response to the outside review; applications submitted for new tenure-track positions since 1998; the outcome of those searches; and enrollment and graduation data.

### **Five-Year Program Review/Self-Study (AY2004-2005)**

Summary of specific areas of the Self-Study

- Previous review summary and accomplishments  
In the last review (2000), the Department plans for Mathematics were: (i) revision of the courses for prospective elementary teachers, (ii) review of Math 3000, Introduction to Abstract Mathematics and Proofs (iii) review of the calculus/analysis sequences, (iv) consideration of a C.S. option in the math major (v) review of remedial courses (vi) review of courses used by Engineering students (vii) development of capstone courses, and (viii) addition of a course in mathematical modeling. All of these plans have been addressed. (i) The courses for elementary mathematics education (Math 4021-4024) were thoroughly revised and are now Math 2011/4012/4013/4014. (ii) Based on the conviction of our

faculty that students needed additional preparation for upper division, theoretical mathematics courses, the Department voted to add Math 3000, Introduction to Abstract Mathematics and Proofs, to the list of required courses for all mathematics majors. (iii) The faculty are exploring the possibility of requiring an additional course in vector calculus of all mathematics majors. (iv) Given the trend in computer science enrollments in recent years, there has been no significant demand for a computer science option in the mathematics major, and no such option has been seriously considered. (v) The Department has reviewed, on an ongoing basis, the remedial courses in mathematics, in light of the changes in the Entry Level Mathematics Exam and the Chancellor's Executive Order to limit remediation to one year. (vi) After initial trials of having Engineering students take Math 3841, Linear Programming, a mutual decision was made by Math/CS and Engineering that Industrial Engineering students would be better served by a separate course, ENGR 3841, Operations Research I. (vii) Mathematics majors in the Mathematics Teaching option are required to take a capstone course, Math 4901 (Senior Seminar.) (viii) In its searches for new mathematics faculty, the Department concentrated on those applicants who could develop and teach a course in mathematical modeling, successfully hiring so that a new course in Mathematical Modeling Math 3865) was offered Fall 2005.

- See faculty trends and accomplishments below under planning for an analysis of faculty.
- Assessment: Gateway courses reflect the challenging nature of mathematics – no automatic good grades in any course. The relatively low pass rate in Math 2304 (roughly 2/3 of those who begin manage to end the course with a C or better; more than 10% usually withdraw) reflects also the many non-math majors who must take this course. Of the upper division courses, analysis (Math 3300) is difficult for many students. But on the whole, upper division math students do succeed in the courses that they take. No pass rates for MS exams were given because the exam has changed and data are not comparable from past exams.

Gateway Course	Total	Exc	Good	Adequate	Poor	Fail	Withdraw	Number Succeed	PerCent Succeed
2304	1,208	19.1	24.3	23.2	8.1	13.9	11	809	67
3000	127	29.1	26.8	22	9.4	8.7	3.1	100	78.7
3100	301	15.9	23.9	30.2	8	9	12	214	71.1
3122	92	27.2	30.4	22.8	7.6	8.7	2.2	75	81.5
3301	140	30.7	32.1	30.7	2.9	1.4	2.1	131	93.6
4901	58	74.1	15.5	1.7	0	3.4	3.4	54	93.1

The Math 3000 course was added to the curriculum in Fall 2000 to meet a need for math majors to succeed in upper division courses requiring proofs. The Department is glad to see the high rate of success in 3000, plus strong rates in the other upper division courses.

The Math 4901 course is the capstone course for students in the Teaching Option. It is also encouraging to note that over 93% of the students who started this course finished it successfully.

- Basic comparisons:
  - (1) Students do succeed as mathematics majors. They find the courses challenging, but they are able to finish the courses and the degrees.
  - (2) Students are generally happy with the level of instruction in math courses. A wide variety is cited as examples of excellence in exit surveys. Few complaints are registered – none about instructors in upper-division courses.
  - (3) The major is relatively small (at least compared to Computer Science). Not all required courses are offered each quarter, and often not in both day/evening sections. Students do find it hard to schedule their classes, given these limited offerings. It should be noted though, that with the increase in enrollment at the 3000-4000 level, more sections are now offered.
  - (4) Since 2000, the CSUEB math major program has grown 71%. %. This is the 3<sup>rd</sup> highest percentage increase in the whole system, except for Long Beach and San Bernardino,
  - (5) Compared to the relative size of the other universities, CSUEB currently has a large number of math majors -- more than either San Francisco State or San Jose State.

(6) The options – pure, applied, teaching – are standard. Many schools, especially those of a comparable size, do not offer all three of these options. Other schools may also offer a statistics option; at CSUEB, that would be done with a major in the Statistics department

- Summary of supporting data

See Table 1 below under student trends. Upper-division coursework is increased but service areas are expected to decrease in the future.

### **Outside Reviewer's Comments & the Department's Response**

Dr. Dale Oliver, Professor of Mathematics, Humboldt State University, spent more than a day visiting the Department. Dr. Oliver is quite familiar with the CSU system. He has also been involved with preparing mathematics teachers – one of the main concerns of the CSUEB department. The following is a summary of the issues raised and the response by the Department faculty.

#### **Challenges for the department – Short term**

*Curriculum* 1) Vector Calculus: This question has been open to debate for more than five years -- how much calculus/analysis should be required of mathematics majors. For instance, we require one year of calculus, whereas many other institutions require a year and a half. The Mathematics Undergraduate Curriculum Committee and the department as a whole will revisit this issue.

2) The senior seminar for prospective teachers: The recommendation that Math 4901 be increased to 4 units will be studied immediately, since the program is currently being prepared for the new program standards of the California Commission on Teacher Credentialing. Again, this will be studied by the Mathematics Undergraduate Curriculum Committee, particularly those members (Hann, Callahan) who have been writing the new program standards document.

#### **Challenges for the Department – Long Term**

*Leadership Development* Issues to explore here include (1) appropriate release time and (2) development of young faculty.

*Graduate program – Option II MATH Secondary Teaching* The Department is aware that this Option is not serving an educational need at this time. The Mathematics Graduate Committee will consider revising the Option for a different audience.

*Promoting Scholarly Activities* The retirement of some faculty most involved in scholarly activities is a concern. The Department will try to stimulate more scholarly activities through grant writing initiative rewards and release time.

#### **Additional Opportunities: Ideas to explore for the future**

*Applied Mathematics* The Department is proud to now be offering Mathematical Modeling, and in Spring 2006, a new course in Mathematical Physics. It must be open to other new interdisciplinary courses.

*Institutionalizing support for prospective math teachers with non-traditional backgrounds* The idea of a program tailored for middle school math teachers is attractive, as is the idea of a new minor (or other program) that certifies a “cohesive body of mathematical study.” The Undergraduate Curriculum Committee will consider these ideas.

### **Program's Five-Year Strategic Plan (2004-2009)**

Departmental projects

- continue assessment and application of assessment results to curricula
- strengthen ties to community colleges – faculty and students
- arrange more meaningful spatial configurations for dept. offices, labs, library, workroom.
- maintain support for new and current faculty (release time, support funds, travel, etc)
- properly allocate release time for necessary faculty projects (new for CTC coordinator)

- run focus groups of majors to learn more about student needs
- 4-month post-graduation follow-ups on all June 2006 graduates

Mathematics

- meet new CTC requirements for mathematics majors who intend to teach
- add new position of CTC Coordinator to Department Administrative assignments
- analyze applied math courses; possibly add new topics in applied math

- Students and changing trends:

**Student enrollment:** In mathematics, we have experienced a healthy increase in the number of majors in recent years. The number of undergraduate mathematics majors increased from 64 to 104 in the period from Fall 2000 to Fall 2004, while the number of mathematics graduate students more than doubled during this period (28 in 2000; 66 in 2004). Student enrollment in mathematics classes is strong, particularly at the upper division level. These upper division courses attract not only mathematics majors, but also statistics and computer science majors, as well as students preparing to pursue teaching credentials in mathematics. The following table shows the dramatic rise in upper division and graduate mathematics enrollment since Fall 2000.

**Table 1:** *Head count in upper division and graduate mathematics courses (excluding cross-listed computer science and statistics courses and mathematics education courses)*

Fall 2000	Fall 2001	Fall 2002	Fall 2003	Fall 2004
156	178	236	299	349

Since 2000, enrollments in pre-calculus and general education mathematics courses have remained almost constant. However, the number of students taking calculus courses has begun to decline, due primarily to the large decrease in the number of computer science majors. Among our mathematics courses, the greatest decline has been experienced in the courses for future elementary school teachers. These enrollment drops are primarily due to two factors: (1) Teacher education programs no longer require completion of a number systems course as a condition for admission, and (2) Completion of a Liberal Studies major (including its required mathematics sequence) is no longer accepted as proof of subject matter competence for admission to a multiple subjects teaching credential. (Now all candidates must pass an examination, the CSET.) Enrollments in our biggest service courses, Math 1810 and 1820—courses for majors in Business Administration and Economics—have been generally stable since 2000. However, beginning in Fall 2006, the College of Business and Economics will no longer require Math 1820 for most students. Future enrollments in Math 1820 will be a small fraction of the current enrollments.

**Student attendance and participation in conferences, etc.:** Science Festival (2001, 2003, 2005) 10+ students volunteer at each festival, Regional MAA meetings (every year) About 20 students go each year; usually there is at least one student poster presentation. Undergraduate Mathematics Research Conference at Sonoma State (2005, several students attended, Genevieve Granier gave a talk. Tri-Valley Math Conference – 3(?) 2) of our grad students attended this conference in Pleasanton, Sept. 2005. This was an articulation conference between HS, Community College and CSU. An increasing number of our students are attending Summer Institutes in Mathematics. In the Summer of 2004, we had two students attend the Park City Mathematics Institute in Utah. This Winter one of our students will attend the prestigious “Budapest Semester in Mathematics.”

**Other Student Achievements:** Ph.D. programs: In the past five years, we have had students go on to PhD programs in mathematics at various schools Teacher Credentialing: And, during the

period from F '00 through the present, 183 people were certified as having satisfied the requirements of CSUEB's Subject Matter Preparation Program in Mathematics. Of these, 61 received their degrees from CSUEB and 85 others completed some of their required math courses at CSUEB.

**ACCLAIM:** Alameda County Collaborative for Learning and Instruction in Mathematics (ACCLAIM). A partnership with California State University East Bay Mathematics Department, providing summer institutes with school year follow-up, K-12, focused on mathematics content for teachers, lesson design, and assessment. Faculty member Tom Roby is PI and director of ACCLAIM professional development institutes, overseeing a budget of over \$4 million (including stipends) in FY 2001–04.

**Special events on campus:** Mathematics Awareness Week- "Mathematics and the Cosmos", 2005 (talks, games, events), Hosts for the Northern California, Nevada and Hawaii section of the Mathematical Association of America section meeting in Spring 2004. Approximately 200 professors and students from a wide geographical area participated. Friday Colloquium talks 4-6 times per quarter – well attended by faculty and students. Annual Department party – attracts over 70 students and faculty members each June.

Workshops, study groups, other opportunities for students: High School Workshop Program (Summer & Fall 2005), GRE Mathematics Subject Exam Prep Sessions (Summer & Fall 2005), Applying to Math Graduate School Workshop (Summer & Fall 2005), Applied Mathematics Graduate Comprehensive Exam Study Sessions (2004-2006), CSUEB Mathematics Problems Group (2004-2006), Student participation in Putnam exam (2004, 2005), "User-friendly" Math Lab where math students can work together

- Faculty and changing trends:

**Faculty:** At this time, the depth and breadth of the mathematics faculty is strong. However, there will be retirements and other changes; it is necessary to maintain their strength as a resource.

Since 2000, the Department has hired four new tenure-track faculty members in Mathematics: Drs. Jennifer Courter, Rudy Horne, Sarah Frey, and Shirley Yap. Drs. Courter and Horne have been enticed elsewhere. The reasons for these losses do not appear to have been related to dissatisfaction with our department or with the university. Rather, there were issues such as the high cost of housing in the Bay Area and the availability of desirable post-doctoral appointments elsewhere. In our recent hiring, the Department has tried to ensure that all candidates know both the advantages and disadvantages of living in the Bay Area. We are very pleased with our most recent hires, both of whom are quite involved with the activities of our department. A greater level of interest among mathematics students is readily apparent since the arrival of these new faculty members. Some tenure-track faculty in the Department are well published.

**Lecturers:** The pool of mathematics lecturers is quite stable. Drs. Carter and Simutis have taught for us for a long time. New lecturers who also hold a Ph.D. have been available to teach when needed (as in the summer) – for example, Drs. Olkin and Kovaleva. Other lecturers with a long history of success in lower division service courses and mathematics education courses include Fujimura, Becker, Benjamin, Conlan, and Slivinsky. At the current time, we are not adding to our pool of mathematics lecturers. This is good for current stability, but possibly bad if we lose lecturers or experience enrollment increases in the future. Math has some lecturers that are well published

**MAA Northern California Section Award:** Award for “Distinguished College or University Teaching of Mathematics” to faculty member Russ Merris, 2004

- Resources and changing trends:

The department faculty offices are scattered all over campus. Faculty involved in student research need lab space for their work. It is unclear where faculty in Warren Hall will be relocated after the retrofit work begins.

It is very important to maintain and update the library collection and reference materials (books, periodicals, MathSciNet, etc).

#### CAPR Analysis of the Program’s Five-Year Review

The program is strong and growing. The outside reviewer was very positive in his analysis of the program and its potential, offering ideas that might assist the mathematics faculty in the future. The data collected on assessment is appropriate to the program and can be monitored without much intervention in the classroom process. The capstone class will be a source of summative data while gateway courses will continue to provide informative analyses for students and faculty alike. The introduction (in 2000) of the new course MATH 3000 seems to bridge the transition for students from the lower division coursework to the upper-division emphasis on proofs.

CAPR Recommendation for Continuation of the Program: CAPR recommends the continuation of the BS and MS degree programs in Mathematics without modification.

Date of the Program’s next Academic Review: The next CAPR review will be in 2009-10.