

1. Overview

A. Description

Provide a brief description of the proposed minor.

The minor in applied mathematics proposed by the College of Integrative Sciences and Arts at the Polytechnic campus is designed to enable students to understand and apply the mathematics most commonly used in the fields of business, economics, engineering, physics, computer sciences, life sciences, social sciences and sustainability. The minor is recommended for students who plan to major in these diverse fields whether their goal is further graduate study or improved employment options. Although students majoring in nonscientific or nontechnical fields will find the minor more challenging than students majoring in natural sciences, the applied mathematics minor could be of even greater value for such students because of the expanded career opportunities it can offer. The proposed minor provides a rigorous foundation in applied mathematics for students who choose not to complete the entire applied mathematics major. Students completing the minor will learn how to use theories and techniques, such as mathematical modeling, computational methods, and statistics to resolve practical real-world problems. The minor in applied mathematics explores the study of advanced applied mathematical topics with an emphasis on applied sciences. It is designed to enable students to more deeply understand the mathematical concepts most commonly used in engineering, business and the physical, life and social sciences. It is expected that students in the minor will be able to use mathematics to formulate important problems to be solved as well as to construct creative solutions to them.

B. Why should this be a minor rather than a concentration?

This minor provides an excellent opportunity for students who are not applied mathematics majors to strengthen their skills in mathematical reasoning, and in doing so, deepen their understanding of the mathematics in their own major while increasing their marketability for industry or graduate programs.

C. Affiliation

If the minor is affiliated with a degree program, include a brief statement of how it will complement the program. If it is not affiliated with a degree program, incorporate a statement as to how it will provide an opportunity for a student to gain knowledge or skills not already available at ASU.

This minor is affiliated with the BS program in applied mathematics at the Polytechnic campus and is in a unique position to create new mathematical learning opportunities for students coming from a wide range of science and non-science majors. The new applied mathematics minor will not be directly competing with the existing applied mathematics or mathematics minors offered by the College of Liberal Arts and Sciences and New College of Interdisciplinary Arts and Sciences. The newly proposed minor will primarily serve the students on the Polytechnic campus and have a unique emphasis on hands-on and project-based learning that the Polytechnic campus is promoting. This would be the only mathematics minor program at the Polytechnic campus, and as such, it is especially important for the students on the Polytechnic campus who want to further develop their ability in formulating and solving problems in their own majors using mathematical techniques and strategies.

D. Demand

Explain the need for the new minor (e.g., market, student demand, interdisciplinary considerations).

In general, a minor in applied mathematics is of great value to students majoring in natural sciences such as chemistry, biology, engineering and a range of other disciplines. Currently, most of the students at the Polytechnic campus are required to take mathematics courses. The enrollment in such courses grew by about 45% over the last 5 years. Therefore, it is natural to fully utilize the potential of the existing mathematics faculty to create an applied mathematics minor for such a rapidly growing body of students. The applied mathematics minor will broaden students' opportunities, improve the quality of their education and increase their chances for employment.

E. Projected Enrollment

What are enrollment projections for the first three years?

	1st Year	2nd Year (Yr. 1 continuing + new entering)	3rd Year (Yr. 1 & 2 continuing + new entering)
Number of Students (Headcount)	5	12	20

2. Support and Impact

A. Faculty governance

Provide a supporting letter from the chair of the academic unit verifying that the proposed minor has received faculty approval through appropriate governance procedures in the unit and that the unit has the resources to support the minor as presented in the proposal, without impacting core program resources.

This supporting statement is provided and affirmed by Dr. Chris Martin, Faculty Head of the Faculty of Science and Mathematics. On September 21, 2016, the Faculty of Science and Mathematics voted and unanimously approved the applied mathematics minor program. The unit has in place the resources necessary to support this minor as presented without negatively impacting core program resources.

B. Other related programs

Identify other related ASU programs and outline how the new minor will complement these existing ASU programs. (If applicable, statements of support from potentially-affected academic unit administrators need to be included with this proposal submission.)

The new applied mathematics minor will particularly complement the programs already existing at the Polytechnic campus, including applied biological sciences, applied physics, a range of engineering degrees offered by the Polytechnic School and business and management degrees offered by the W.P. Carey School of Business.

Please see attached impact statements from:

- College of Liberal Arts and Sciences
- Ira A. Fulton Schools of Engineering
- New College of Interdisciplinary Arts and Sciences
- W. P. Carey School of Business

C. Letter(s) of support

Provide a supporting letter from each college/school dean from which individual courses are taken. Please see attached.

3. Academic Curriculum and Requirements

A. Knowledge, competencies, and skills

List the knowledge, competencies, and skills (learning outcomes) students should have when they complete this proposed minor. Examples of program learning outcomes can be found at (<http://www.asu.edu/oue/assessment.html>).

Learning outcomes:

- Apply general principles to solving problems
- Use mathematical concepts and methods to describe relationships between different variables in the physical world
- Model and solve real-world problems arising in the physical, life and social sciences as well as in engineering
- Use computer-based technology to collect, analyze and interpret empirical data
- Write and publicly present research and otherwise communicate effectively in a scientific setting

B. Provide a description of the curricular requirements for the minor. Be specific in listing required courses as well as electives and specify the total minimum number of hours required for the minor. Please attach one or more model programs of study to illustrate the choices students might make, if appropriate.

Required Minor Courses

Prefix	Number	Title	Is this a new course?	Credit Hours
MAT	265	Calculus for Engineers I or MAT 270 Calculus with Analytical Geometry I	No	3-4
MAT	266	Calculus for Engineers II or MAT 271 Calculus with Analytical Geometry II	No	3-4
MAT	275	Modern Differential Equations	No	3
Section Sub-total				9-11

Elective Minor Courses

Prefix	Number	Title	Is this a new course?	Credit Hours
MAT	267	Calculus for Engineers III or MAT 272 Calculus with Analytical Geometry III	No	3-4
MAT	300	Mathematical Structures	No	3
MAT	310	Introduction to Geometry	No	3
MAT	343	Applied Linear Algebra	No	3
MAT	499	Individualized Instruction	No	3
STP	420	Introductory Applied Statistics	No	3
Section Sub-total				12

Other Minor Requirements

E.g. – Capstone experience, internship, clinical requirements, field studies, foreign language skills as applicable	Credit Hours
Section Sub-total	0

Total minimum credit hours required for the Minor **21**

C. Minimum residency requirement

How many hours of the minor must be ASU credit?

A minimum of 12 credit hours of the minor must be ASU credit. A minimum of 6 upper-division credit hours in elective courses for the minor must be taken in residence at the Polytechnic campus.

D. New Courses

Provide a brief course description for each new course.

None

Note: All new required courses should be submitted in Curriculum Changemaker and ready for Provost’s Office approval before this certificate is put on Curriculum and Academic Programs Committee (CAPC) agenda

4. Administration and Resources

A. Describe the procedures and any qualifications for enrollment in the minor.

This minor is open to all ASU undergraduate majors. Students should have a 2.00 GPA and be in good academic standing.

B. Describe the advising procedures as well as measures for verification of completion of the minor.

College of Integrative Sciences and Arts advisors will verify that enrolled students have completed all program requirements.

C. What are the resource implications for the proposed minor, including any projected budget needs? Will new books, library holdings, equipment, laboratory space and/or personnel be required now or in the future? If multiple units/programs will collaborate in offering this minor, please discuss the resource contribution of each participating program. Letters of support must be included from all academic units that will commit resources to this minor.

No additional resources needed at this time. Depending on enrollment, it may be necessary to hire an additional instructor of mathematics.

D. Primary Faculty

List the primary faculty participants regarding this proposed certificate. For interdisciplinary certificates, please include the relevant names of faculty members from across the University.

Name	Title	Area(s) of Specialization as they relate to proposed certificate
Dr. Yun Kang	Associate Professor	Mathematical Modeling, Dynamical Systems
Dr. Michelle Zandieh	Associate Professor	Mathematics Education
Dr. Matt Isom	Senior Lecturer	Mathematics Education
Catherine Hart, MS	Senior Lecturer	Mathematics Education, Industrial Mathematics
Dr. Jon Ulrich	Instructor	Applied Statistics
Dr. Shawn Elledge	Instructor	Number Theory
Katherine Czeranko, MS	Instructor	Applied Mathematics, Signal Processing
David Oakes, MS	Instructor	Biological Modelling
Dr. Derar Serhan	Instructor	Mathematics Education
Dr. Durgesh Sharma	Instructor	Operation Research

5. Additional Materials

- A. Appendix
Complete and attach the Appendix document.
- B. Program of study
Provide one or more model programs of study (if appropriate).
- C. Attach other information that will be useful to the review committees and the Office of the Provost.

PROVOST OFFICE APPROVAL(S)	
This proposal has been approved by all necessary Provost office levels of review. I recommend implementation of the proposed organizational change.	
Office of the University Provost	
Signature _____	Date: / /20
<i>Note: An electronic signature, email, or a PDF of the signed signature page is acceptable.</i>	

**APPENDIX
OPERATIONAL INFORMATION FOR MINORS**

(This information is used to populate the Degree Search/catalog website.

Please consider the student audience in creating your text.)

1. Proposed Minor Name: Applied Mathematics

2. Description (150 words maximum)

The minor in applied mathematics in the College of Integrative Sciences and Arts at the Polytechnic campus is designed to enable students to understand and apply mathematics most commonly used in the fields of business, economics, engineering, physics, computer sciences, life sciences, social sciences and sustainability. The minor is recommended for students who plan to major in these diverse fields or for those who are preparing for further graduate study or who wish for increased employment options. The coursework explores the study of advanced applied mathematical topics with an emphasis on applied sciences. Students with a minor in applied mathematics will learn to use theories and techniques, such as mathematical modeling, computational methods, and statistics, to resolve practical real-world problems.

3. Contact and Support Information

Building Name, code and room number: (Search ASU map)	SANCA 233
Program office telephone number: (<i>i.e.</i> 480/965- 2100)	480/727-1526
Program Email Address:	cisa@asu.edu
Program Website Address:	https://cisa.asu.edu

4. Program Requirements: Provide applicable information regarding the program such as curricular restrictions or requirements, specific course lists, or academic retention requirements.

The applied mathematics minor consists of 21 credit hours, including:

Required Courses (9 credit hours)

MAT 265 Calculus for Engineers I, MA (3) or MAT 270 Calculus with Analytical Geometry I, MA (4)
MAT 266 Calculus for Engineers II, MA (3) or MAT 271 Calculus with Analytical Geometry II, MA (4)
MAT 275 Modern Differential Equations, MA (3)

Electives (choose four courses from the list below; 12 credit hours)

MAT 267 Calculus for Engineers III, MA (3) or MAT 272 Calculus with Analytical Geometry III, MA (4)
MAT 300 Mathematical Structures, L (3)
MAT 310 Introduction to Geometry (3)
MAT 343 Applied Linear Algebra (3)
MAT 499 Individualized Instruction (3)
STP 420 Introductory Applied Statistics, CS (3)

At least six upper-division credit hours in elective courses must be taken in residence at the Polytechnic campus.

A minimum of 12 credit hours of the minor must be ASU credit.

Depending upon a student's undergraduate program of study, prerequisite courses may be needed in order to complete the requirements of this minor.

5. Additional Enrollment Requirements If applicable list any additional enrollment requirements students must complete

GPA Requirement: 2.00

Majors Ineligible to Add this Minor: None

Other Enrollment Requirements: MAT 170 or 171 with C or better, OR Mathematics Placement Test with a score of 60% or higher and the Advanced Math Placement Test with a score of 38 or higher, OR ALEKS score of 76 or higher

The minor in applied mathematics is open to all ASU undergraduate majors. Students should consult an advisor in the department of their major to determine if the minor is consistent with their educational goals and to be recognized in their particular major. A student wishing to pursue this minor at the Polytechnic campus should also consult an academic advisor in the unit offering that minor to ensure enrollment in an appropriate set of courses.

Students in most majors may pursue at least one minor and, upon successful completion of the prescribed coursework, have that accomplishment officially recognized on the ASU transcript at graduation if the college or department of the minor officially certifies, through established verification procedures, that all requirements for the minor have been met and the college (and in certain colleges, the department) of the student's major allows the official recognition of the minor.

Note: Certain major and minor combinations may be deemed inappropriate either by the college or department of the major or minor. Courses taken as part of a minor may not count toward both the major degree and the minor. Students should contact the department for more information.

6. Delivery/Campus Information Delivery: On-campus only (ground courses and/or iCourses)

Note: Once students elect a campus or On-line option, students will not be able to move back and forth between the on-campus and the ASU Online options. Approval from the Office of the Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online.

7. Campus/Locations: indicate all locations where this program will be offered.

- Downtown Phoenix Polytechnic Tempe Thunderbird West Other:

APPENDIX II

Proposal to Establish a Minor College of Integrative Sciences and Arts

Applied Mathematics

The College of Integrative Sciences and Arts Curriculum Committee approved the proposal for the minor in Applied Mathematics on March 1, 2017.

Impact Statement – College of Liberal Arts and Sciences

From: Ferran Garcia-Pichel
Sent: Monday, March 27, 2017 7:38 PM
To: Duane Roen <Duane.Roen@asu.edu>
Subject: Re: Applied Mathematics Minor - Impact Statements

I think this should be fine, since you have the major already.
Ferran

Impact Statement – Fulton Schools of Engineering

From: Ann McKenna
Sent: Tuesday, February 21, 2017 10:05 AM
To: Duane Roen <Duane.Roen@asu.edu>
Subject: Re: Applied Mathematics Minor - Impact Statements

Hi Duane,
The Polytechnic School supports the establishment of a minor in applied mathematics, in CISA.
Best,
Ann

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Ann F. McKenna, PhD
Professor and Director, The Polytechnic School
Ira A. Fulton Schools of Engineering
Arizona State University
6049 S Backus Mall, Sutton Hall 140
Mesa, AZ 85212
Phone: 480-727-5212
Email: ann.mckenna@asu.edu

Impact Statement – New College of Interdisciplinary Arts and Sciences

From: Todd Sandrin
Sent: Monday, February 20, 2017 3:38 PM
To: Duane Roen <Duane.Roen@asu.edu>
Subject: RE: Applied Mathematics Minor - Impact Statements

Duane,

New College anticipates no negative impacts here.

Thanks!
Todd

Impact Statement – W.P. Carey School of Business

From: Kay Faris
Sent: Wednesday, March 01, 2017 9:42 AM
To: Duane Roen <Duane.Roen@asu.edu>
Cc: Kay Faris <KAY.FARIS@asu.edu>
Subject: FW: Applied Mathematics Minor - Impact Statements

Dear Duane,

The W. P. Carey School of Business sees no negative impact with the Applied Mathematics Minor. In fact, this minor will be a great addition to the curriculum offerings at the Polytechnic Campus and we hope our students will take advantage of this opportunity.

Please let me know if you have additional questions.

Thanks,

Kay

Kay A. Faris
Senior Associate Dean, Academic Programs
W. P. Carey School of Business
Arizona State University
Tempe, AZ 85287-3406
Phone: 480-965-7587
Fax: 480-965-3846
Kay.Faris@asu.edu

From: Duane Roen
Sent: Monday, February 20, 2017 2:14 PM
To: Kay Faris <KAY.FARIS@asu.edu>; Todd Sandrin <Todd.Sandrin@asu.edu>; Ann McKenna

<Ann.McKenna@asu.edu>; Ferran Garcia-Pichel <ferran@asu.edu>

Subject: Applied Mathematics Minor - Impact Statements

Kay, Todd, Ann, and Ferran,

When CISA established the Applied Mathematics major at Poly last year, we should have also established a minor, but we did not.

Attached to this message is a proposal to establish a minor.

If each of you could offer an impact statement in response to the proposal, that would be wonderful.

Thank you for considering this request.

Best,
Duane

Duane Roen

Vice Provost, Polytechnic campus
Dean, College of Integrative Sciences and Arts
Dean, University College
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