

The completed and signed proposal should be submitted by the Dean's Office to: curriculumplanning@asu.edu. Before academic units can advertise undergraduate certificates or include them in their offerings as described in the university catalogs, they must be recommended for approval by the Senate Curriculum and Academic Programs Committee and the University Senate, and be approved by the Office of the University Provost.

Definition and minimum requirements:

These are the minimum requirements for approval. Individual undergraduate certificates may have additional requirements. An undergraduate certificate is a programmatic or linked series of courses from a single field or one that crosses disciplinary boundaries and may be freestanding or affiliated with a degree program. The certificate provides a structured and focused set of courses that can be used to enhance a student's baccalaureate experience or professional development.

An undergraduate certificate program:

- Requires a minimum of 15 credit hours of which at least 12 credit hours must be upper division
- Requires a minimum grade of "C" or better for all upper-division courses
- Consists of courses that must directly relate in whole or large part to the purpose of the certificate. Example: Geographic area certificates must include only courses specific to the title of the certificate, other than a non-English language
- Is cross disciplinary; or,
 - Certified by a professional or accredited organization/governmental agency; or,
 - Clearly leads to advanced specialization in a field; or,
 - Is granted to a program that does not currently have a major

College/School/Institute: College of Liberal Arts and Sciences
Department/Division/School: School of Mathematical and Statistical Sciences
Proposed certificate name: Mathematical Concepts of Engineering
Requested effective date: Spring 2019

Delivery method and campus or location options: select all locations that apply

- Downtown Phoenix
 Polytechnic
 Tempe
 Thunderbird
 West
 Other: Online
- Both on-campus and** ASU Online* - (check applicable campus(es) from options listed above)
- ASU Online only (all courses online and managed by ASU Online)

Note: Once students elect a campus or online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please contact Ed Plus then complete the ASU Online Offering form in Curriculum ChangeMaker to begin this request.

Proposal Contact

Name: Joseph Davis **Title:** Assistant Director for Academic Services
Phone number: 480-965-1167 **Email:** Joseph.w.davis@asu.edu

DEAN APPROVAL(S)

This proposal has been approved by all necessary unit and College/School levels of review. I recommend implementation of the proposed organizational change.

College/School/Division Dean name: Paul LePore

Signature _____ **Date:** 07/18/2018
College/School/Division Dean name:
 (if more than one college involved)
Signature _____ **Date:** / / 20

1. Overview

Provide a brief description of the new certificate.

The study of mathematics provides a solid foundation for engineering. By focusing on mathematical concepts of engineering, students will enhance their degree by utilizing an interdisciplinary approach to engineering with an emphasis on Linear Algebra, Probability, and Statistical applications. The certificate in Mathematical Concepts of Engineering is ideal for those looking to expand their knowledge of engineering or to pursue graduate studies in engineering fields.

A. This proposed certificate (check one):

- is cross disciplinary; or
- is certified by a professional or accredited organization/governmental agency; or,
- clearly leads to advanced specialization in a field; or,
- is granted to a program that does not currently have a major

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

This program is interdisciplinary with courses belonging to the School of Mathematical & Statistical Sciences and Fulton Schools of Engineering. The certificate is designed to show that a student has become proficient in this specific content area that shares coursework between the two programs.

C. Affiliation

If the certificate program 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 certificate will provide an opportunity, especially for digital immersion students, to specialize in coursework that utilizes mathematical foundations in engineering. For both campus and digital immersion students, this opportunity does not yet exist. However, while campus immersion students do have the opportunity to minor in mathematics, the minor does not focus on applications to engineering, which allows the certificate to stand on its own.

D. Demand

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

The current market is seeing steady growth in STEM fields with large increases coming from mathematically oriented fields in science(1). A certificate related to mathematics retains a strong link to career utilization (2).

1. <https://www.nsf.gov/nsb/sei/edTool/data/workforce-03.html>
2. <https://www.nsf.gov/nsb/sei/edTool/data/workforce-06.html>

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 | 10 | 21 |

2. Support and Impact

A. Faculty governance

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

See attached letter from Al Boggess, Director of the School of Mathematical and Statistical Sciences

B. Other related programs

Identify other related ASU programs and outline how the new certificate 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.)

This certificate will complement most programs in the School of Mathematical & Statistical Sciences and Fulton Schools of Engineering. By showing proficiency in the mathematical foundations of engineering, students are able to not only find real world applications of what they are learning in mathematics based courses, but will find an enhanced knowledge and skillset as students approach engineering problems.

See attached letters of support from College of Integrative Sciences and Arts and New College.

C. Letter(s) of support

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

See attached supporting documents from School of Mathematical & Statistical Sciences and the Fulton Schools of Engineering.

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 certificate. Examples of program learning outcomes can be found at (<https://uoeee.asu.edu/assessment>).

Learning Outcome 1: Students receiving this certificate will be able to think critically about the implementation of algorithms in engineering and physics.

*In MAT 275, students will complete an embedded project that utilizes a programming language to implement algorithms used to simulate problems in engineering and physics. Students will be assessed against a faculty rubric that focuses on problem solving, critical thinking, and correctness.

*In MAT 343, students will complete an embedded final project utilizing a programming language to apply algorithms to large systems of linear equations. Students will be assessed against a faculty rubric focused on effectiveness, problem solving and correctness.

Learning Outcome 2: Students will be able to develop teamwork skills, critically engage with real world problems, and communicate solutions while applying probability and statistics concepts to problems in engineering.

*In IEE 380, students will complete an embedded project that requires them to work in teams to create a technical memo that focuses on the application of statistical methods to engineering. Students will be assessed against a faculty-developed rubric that focuses on critical thinking, teamwork, and correctness.

*In IEE 380, students will complete a final exam that focuses on the applications of probability and statistics to engineering. Students will be assessed on their thoroughness and correctness.

B. Enrollment criteria

Describe the procedures and any qualifications for enrollment in the proposed certificate. If they are identical to the admission criteria for the existing major and degree program under which this certificate will be established, please note that.

Students must be in good standing at Arizona State University with a 2.00 cumulative grade point average. All majors are eligible to add this certificate. Students in Fulton Schools of Engineering and the School of Mathematical and Statistical Sciences are not prohibited from pursuing this certificate.

C. Program Map

Attach a copy of the “proposed” map for this certificate program. Instructions on how to create a “proposed certificate map” in [BAMM](#) can be found in the [Build a Major Map Training Guide](#).

D. Curricular structure

Provide the curricular structure for this certificate. Be specific in listing required courses and specify the total minimum number of hours required for the certificate.

| Required certificate courses | | | | |
|------------------------------|--------|--|-----------------------|--------------|
| Prefix | Number | Title | Is this a new Course? | Credit Hours |
| IEE | 380 | Probability and Statistics for Engineering Problem Solving | No | 3 |
| MAT | 266 | Calculus for Engineers II | No | 3 |
| MAT | 267 | Calculus for Engineers III | No | 3 |
| MAT | 275 | Modern Differential Equations | No | 3 |
| MAT | 343 | Applied Linear Algebra | No | 3 |
| STP | 420 | Introductory Applied Statistics | No | 3 |
| <i>Section sub-total:</i> | | | | 18 |
| Elective certificate courses | | | | |
| Prefix | Number | Title | Is this a new Course? | Credit Hours |
| IEE | 381 | Lean Six Sigma Methodology | No | 3 |
| IEE | 385 | Engineering Statistics: Probability | No | 3 |
| IEE | 470 | Stochastic Operations Research | No | 3 |
| <i>Section sub-total:</i> | | | | 3 |

| Other certificate requirements | Credit Hours |
|---|--------------|
| E.g. – Capstone experience, internship, clinical requirements, field studies, foreign language skills as applicable | |
| | |
| | |
| <i>Section sub-total:</i> | 0 |
| Total minimum credit hours required for certificate | 21 |

E. Minimum residency requirement
How many hours of the certificate must be ASU credit?

12

F. New courses
Provide a brief course description for each new course.

No new courses

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. Administration

How will the proposed certificate be administered (including admissions, student advisement, retention, etc.)?

This program will be advised through the School of Mathematical & Statistical Sciences undergraduate advising office. The school will take responsibility for admissions and retention. College of Integrative Sciences and Arts may utilize this as one of the concentrations for the BA in interdisciplinary studies degree and would serve as advisors for that population.

B. Resources

What are the resource implications for the proposed certificate, 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 certificate 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 certificate.

This program needs no additional resources as all classes currently exist. All services needed will be administered by current staff and faculty. All School of Mathematical & Statistical Sciences led classes are able to be taught by any school faculty member.

C. 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 |
|-------------------|---------------------|--|
| Jay Abramson | Principal Lecturer | Mathematics |
| Dr. Linda Chattin | Principal Lecturer | Industrial Engineering |
| Oleksandr Lytvak | Lecturer | Mathematics |
| Richard Ruedemann | Principal Lecturer | Mathematics |
| Bruno Welfert | Associate Professor | Mathematics and MATLAB |
| | | |

5. Additional Materials

- A. Complete and attach the Appendix document.
- B. 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.

APPENDIX
OPERATIONAL INFORMATION FOR UNDERGRADUATE CERTIFICATES

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

Please consider the student audience in creating your text.)

1. Proposed Certificate Name: Mathematical Concepts of Engineering

2. Marketing Description

Optional. 50 words maximum. The marketing description should not repeat content found in the program description.

Are you are intellectually curious and eager to expand your knowledge of engineering or interested in graduate study in engineering fields? This certificate features an integrated approach that offers a deeper look at the ways math and engineering intersect and inform each other.”

3. Program Description (150 words maximum)

The certificate program in mathematical concepts of engineering is designed for students who seek a strong foundation in mathematics to support their studies in engineering. Combining a core foundation in the quantitative and analytical skills found in the field of mathematics with related skills in engineering fields, the certificate provides students with a solid mathematical background well-suited for multiple career paths.

4. Contact and Support Information

| | |
|---|----------------------|
| Building code and room number: (Search ASU map) | WXL R 211 |
| Program office telephone number: (<i>i.e.</i> 480/965-2100) | 480/965-7195 |
| Program Email Address: | math@asu.edu |
| Program Website Address: | https://math.asu.edu |

5. Program Requirements

Remember to attach a copy of the “proposed” map for this certificate program. Instructions on how to create a “proposed certificate map” in [BAMM](#) can be found in the Build a Major Map Training Guide.

1. Enrollment Requirements

If applicable, list any special enrollment requirements applicable to this certificate in addition to the standard text. Enrollment requirements for all undergraduate certificates include the following text:

A student pursuing an undergraduate certificate must be enrolled as a degree-seeking student at ASU. Undergraduate certificates are not awarded prior to the award of an undergraduate degree. A student already holding an undergraduate degree may pursue an undergraduate certificate as a nondegree-seeking graduate student.

Students must have completed MAT 265 or MAT 270 with a “C” or higher prior to enrolling in the certificate. Students also must be in good academic standing with a minimum of a 2.00 cumulative grade point average.

7. Keywords

List no more than 5-7 keywords that can be used to search for this program. Keywords should be specific to the proposed program. All parts of the certificate name are automatically included as keywords.

Statistics, Probability, Information Systems, Systems Analysis

8. Delivery/Campus Information Options: Both, On-Campus and ASU Online

Note: Once students elect a campus or online option, students will not be able to move 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.

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

Downtown Phoenix
 Polytechnic
 Tempe
 Thunderbird
 West
 Other: Online

2018 - 2019 CERTIFICATE Map

Mathematical Concepts of Engineering (Proposed)

Program Requirements

The mathematical concepts of engineering certificate requires a minimum of 21 credit hours. At least 12 credit hours must be completed in upper-division coursework and at least nine credit hours must be completed at ASU. At least six upper-division hours in the certificate must be completed in courses offered by the College of Liberal Arts and Sciences. A grade of "C" (2.00 on a 4.00 scale) or higher is required for each course used to fulfill a certificate requirement.

Required Courses -- 18 credit hours

IEE 380: Probability and Statistics for Engineering Problem Solving (CS) (3)
MAT 266: Calculus for Engineers II (MA) (3)
MAT 267: Calculus for Engineers III (MA) (3)
MAT 275: Modern Differential Equations (MA) (3)
MAT 343: Applied Linear Algebra (3)
STP 420: Introductory Applied Statistics (CS) (3)

Electives (choose one) -- 3 credit hours

IEE 381: Lean Six Sigma Methodology (3)
IEE 385: Engineering Statistics: Probability (3)
IEE 470: Stochastic Operations Research (3)

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

March 13, 2018

To: Dr. Paul LePore, Associate Dean, CLAS (and Ms. Jenny Smith, Assistant)
From: Al Boggess, Director, School of Mathematical and Statistical Sciences
Re: Proposed Mathematical Concepts of Engineering certificate



This is a strong letter of support for the proposed Mathematical Concepts of Engineering certificate. The School of Mathematical & Statistical Sciences is prepared, with support from CLAS and the Provost's office, to staff and administer this program.

This certificate has the support of our undergraduate program committee, which is charged with overseeing the undergraduate programs and course offerings within SOMSS as consistent with our bylaws.

Please let me know if you have any questions or concerns about this proposed certificate.

Cc: Don Jones, Associate Professor

----- Forwarded message -----

From: James Collofello <JAMES.COLLOFELLO@asu.edu>

Date: Tue, May 22, 2018 at 1:42 PM

Subject: RE: letter of support

To: Fabio Milner <fmilner@asu.edu>

Fabio,

We are supportive of this proposal and do not have concerns.

jim

James S. Collofello

Vice Dean for Academic and Student Affairs

Professor of Computer Science and Engineering

School of Computing Informatics and Decision Systems Engineering

Ira A. Fulton Schools of Engineering

Arizona State University

From: Fabio Milner <fmilner@asu.edu>

Sent: Tuesday, May 22, 2018 11:58 AM

To: James Collofello <JAMES.COLLOFELLO@asu.edu>

Cc: Fabio Milner <fmilner@asu.edu>

Subject: Re: letter of support

Jim,

I forgot to mention that this is something we are creating because your FSE requested it.

Any news?

Thanks,

Fabio

Fabio Augusto Milner, PhD
Director of Mathematics for STEM Education
School of Mathematical and Statistical Sciences
Arizona State University
P.O. Box 871804
Tempe, AZ 85287-1804
Phone: (480) 965-4522
Fax: (480) 965-5569

On Wed, Mar.28, 2018 at 12:42 PM, James Collofello <JAMES.COLLOFELLO@asu.edu> wrote:

Fabio,

I will be your point of contact on this. Let me look into it a bit and I will get back with you regarding any issues or concerns.

jim

James S. Collofello

Vice Dean for Academic and Student Affairs

Professor of Computer Science and Engineering

School of Computing Informatics and Decision Systems Engineering

Ira A. Fulton Schools of Engineering

Arizona State University

From: Fabio Milner <fmilner@asu.edu>
Sent: Wednesday, March 28, 2018 12:27 PM
To: James Collofello <JAMES.COLLOFELLO@asu.edu>
Cc: Fabio Milner <fmilner@asu.edu>
Subject: letter of support

Dear Jim,

We are currently submitting a proposal to establish a new certificate (Mathematical Concepts of Engineering). In this process, we will need to ask your School for a letter of support to send up the approval chain.

I enclose the proposal draft and the letter that Al Boggess sent to our College (Paul Lepore already gave the approval and support for CLAS).

Who would be the person at Ira Fulton Schools of Engineering to give us the letter of support?

Thanks so much,

Fabio

Fabio Augusto Milner, PhD
Director of Mathematics for STEM Education
School of Mathematical and Statistical Sciences
Arizona State University
P.O. Box 871804
Tempe, AZ 85287-1804
Phone: (480) 965-4522
Fax: (480) 965-5569

Joseph Davis (Mathematics)

From: Stacey Kimbell
Sent: Thursday, July 5, 2018 7:57 AM
To: Joseph Davis (Mathematics)
Cc: Patricia Friedrich; Lara Ferry; Stephen Wirkus
Subject: New College Letter of Support - Math Concepts of Engineering Certificate

Good morning,

The New College School of Mathematical and Natural Sciences is pleased to support the Mathematical Concepts of Engineering certificate proposal. If you need anything further, please let us know at your earliest convenience.

Sincerely,
Stacey

Stacey Kimbell

Executive Admin Support Specialist and Curriculum Coordinator
Academic Administration and Curriculum Planning
ASU New College of Interdisciplinary Arts and Sciences
Voice: (602) 543-6150 Fax: (602) 543-4565

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From: Joseph Davis (Mathematics)
Sent: Friday, June 29, 2018 2:06 PM
To: Catherine Kerrey <Catherine.Kerrey@asu.edu>
Cc: Donald Jones <dajones@asu.edu>; Jenny Smith <jenny.smith@asu.edu>
Subject: Certificate- Letter of Support

Good Afternoon,

The School of Mathematical & Statistical Sciences has developed a new certificate (Mathematical Concepts of Engineering). The proposed certificate would involve coursework involving math and engineering (IEE). As we go through the approval process, New College has been identified as a College which could potentially supply a letter of support for the creation of the new certificate due to New College's current offerings.

I've attached the proposal as it currently stands which will include the certificate structure. Would New College be able to provide the letter of support for this certificate? Our deadline for consideration is July 27th.

Thank you so much for your consideration.

Take Care,
Joe

Joe Davis, Assistant Director, Academic Services
ASU SCHOOL of MATHEMATICAL & STATISTICAL SCIENCES
Main: [480.965.7195](tel:480.965.7195) | Direct: [480.965.1167](tel:480.965.1167) | Fax: [480.965.5569](tel:480.965.5569) | e-mail: joseph.w.davis@asu.edu

Joseph Davis (Mathematics)

From: Duane Roen
Sent: Friday, June 29, 2018 2:29 PM
To: Joseph Davis (Mathematics)
Cc: Donald Jones; Jenny Smith; Nancy Gonzales; Paul LePore; Therese Aguayo
Subject: RE: Certificate- Letter of support

Joseph,

After checking with the appropriate faculty heads, I am happy to support the CLAS proposal for a certificate in Mathematical Concepts of Engineering.

Best,
Duane

Duane Roen
Vice Provost, Polytechnic campus
Dean, College of Integrative Sciences and Arts
Dean, University College
Arizona State University
Mail Code: 2780
7271 E Sonoran Arroyo Mall
Mesa, AZ 85212-6415
P: 480-727-6513

From: Joseph Davis (Mathematics)
Sent: Friday, June 29, 2018 2:04 PM
To: Therese Aguayo <Taguayo@asu.edu>; Duane Roen <Duane.Roen@asu.edu>
Cc: Donald Jones <dajones@asu.edu>; Jenny Smith <jenny.smith@asu.edu>
Subject: Certificate- Letter of support

Good Afternoon,

The School of Mathematical & Statistical Sciences has developed a new certificate (Mathematical Concepts of Engineering). The proposed certificate would involve coursework involving math and engineering (IEE). As we go through the approval process, CISA has been identified as a College which could potentially supply a letter of support for the creation of the new certificate due to CISA's current course offerings.

I've attached the proposal as it currently stands which will include the certificate structure. Would CISA be able to provide the letter of support for this certificate? Our deadline for consideration is July 27th.

Thank you so much for your consideration.

Take Care,
Joe

Joe Davis, Assistant Director, Academic Services
ASU SCHOOL of MATHEMATICAL & STATISTICAL SCIENCES
Main: [480.965.7195](tel:480.965.7195) | Direct: [480.965.1167](tel:480.965.1167) | Fax: [480.965.5569](tel:480.965.5569) | e-mail: joseph.w.davis@asu.edu



MEMORANDUM

To: Joseph Davis
From: Casey Evans
Date: July 27, 2018
Subject: Undergraduate Certificate, Mathematical Concepts of Engineering

Dear Joseph,

Congratulations!

The Undergraduate Certificate, Mathematical Concepts of Engineering program has received support from Dean Phil Regier to be offered through ASU Online. This program must complete university governance reviews for formal approval. Please include this support memo along with your proposal submission when it is submitted formally to the university (to curriculumplanning@asu.edu) by your dean or their designee.

Please note that in order to proceed with implementation, final approval must be supplied by the university provost.

Once again, congratulations! We are excited to work with you on your new program.
Thank you!

Casey Evans
Director, Academic Program Management
EdPlus at ASU
Arizona State University
Phone: (480) 884-1631
Casey.l.evans@asu.edu

CC: Jennifer Shea