

New Academic Program Workflow Form

General

Proposed Name: Additive Manufacturing

Transaction Nbr: 00000000000130

Plan Type: Specialization

Academic Career: Undergraduate

Degree Offered: Undergraduate Certificate

Do you want to offer a minor? N

Anticipated 1st Admission Term: Sprg 2023

Details

Department(s):

ENGR

DEPTMNT ID	DEPARTMENT NAME	HOST
2804	Materials Science & Engineering	Y

Campus(es):

MAIN

LOCATION	DESCRIPTION
TUCSON	Tucson

Admission application terms for this plan: Spring: Y Summer: Y Fall: Y

Plan admission types:

Freshman: Y Transfer: Y Readmit: Y Graduate: N

Non Degree Certificate (UCRT only): Y

Other (For Community Campus specifics): N

Plan Taxonomy: 14.3601, Manufacturing Engineering.

Program Length Type: Program Length Value: 0.00

Report as NSC Program:

SULA Special Program:

Print Option:

Diploma: Y Undergraduate Certificate in Additive Manufacturing

Transcript: Y Undergraduate Certificate in Additive Manufacturing

Conditions for Admission/Declaration for this Major:

n/a

Requirements for Accreditation:

n/a

Program Comparisons

University Appropriateness

The Materials Science and Engineering Dept. at UA has initiated and led the development of the Additive Manufacturing Initiative (AMI ami.arizona.edu) that includes faculty affiliates and research activities from across the University (including the Colleges of Engineering, Science, Optical Sciences, Architecture, Medicine, and the Lunar and Planetary Lab). Moreover, the Initiative is leading the development of a new state-wide partnership in AM with ASU and NAU. The focus on AM at UA and the development of a new certificate will leverage an existing minor in this critical area. In this case, the certificate will enable non-degree seeking students as well as non-traditional students (i.e. industry students seeking new qualifications) to access this educational opportunity to augment their existing educational background and expertise. The establishment of an AM certificate was motivated by discussions with regional industrial partners (including Honeywell Aerospace, PADT, Raytheon) who recognize the need for workforce development in this rapidly evolving advanced manufacturing method and, indeed, strongly support efforts in AM education and training through CoE senior capstone project funding, for example. The certificate will also provide a new mechanism for growth of the College of Engineering's collaboration with Pima Community College through new credit transfer opportunities. In addition to existing transfer opportunities with PCC's Engineering program, the AM certificate will also directly connect to the Applied Technology (AT) program at PCC, leveraging an established manufacturing-based curriculum and large-scale teaching facility. This broad-based interest and support from the manufacturing community, the established curriculum offerings both regionally (ASU, CSM, UTEP) and nationally, as well as the opportunity to broaden UA's partnership with PCC provides the strong impetus for the new certificate. The proposed certificate in AM will provide a state-of-the-art educational and professional preparatory option for our CoE majors, non-degree

seeking students and non-traditional students in an area of significant impact in the engineering field as well as develop new interest and enhanced recruitment opportunities in the College.

Arizona University System

NBR	PROGRAM	DEGREE	#STDNTS	LOCATION	ACCRDT
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Peer Comparison

please see chart.

Faculty & Resources

Faculty

Current Faculty:

INSTR ID	NAME	DEPT	RANK	DEGREE	FCLTY/%
02303709	David Poirier	2804	Professor	Doctor of Philosophy	6.66
02513295	Hannah Budinoff	2302	Assit. Prof	Doctor of Philosophy	6.66
02700368	Tribikram Kundu	2308	Professor	Doctor of Philosophy	6.66
02706391	Muluneh Yitayew	1230	Professor	Doctor of Philosophy	6.66
04102643	Cholik Chan	2305	Professor	Doctor of Philosophy	6.66
12204434	Krishna Muralidharan	2804	Assoc. Prof	Doctor of Philosophy	6.66
13907288	Barrett Potter	2804	Professor	Doctor of Philosophy	6.76
15108087	Douglas Loy	2804	Professor	Doctor of Philosophy	6.66
15305415	Samy Missoum	2305	Professor	Doctor of Philosophy	6.66
17106027	Erica Corral	2804	Assoc. Prof	Doctor of Philosophy	6.66
17109846	Jian Liu	2302	Assoc. Prof	Doctor of Philosophy	6.66
17503628	Brian Cunningham	2302	Adj. Lect.	Doctor of Philosophy	6.66
22052002	Zoltan Szabo	2305	Adj. Lect.	Doctor of Philosophy	6.66
22084791	Andrew Wessman	2804	Professor	Doctor of Philosophy	6.66
22091671	Sammy Tin	2804	Professor	Doctor of Philosophy	6.66

Additional Faculty:

none

Current Student & Faculty FTE

DEPARTMENT	UGRD HEAD COUNT	GRAD HEAD COUNT	FACULTY FTE
2804	40	35	13.00

Projected Student & Faculty FTE

	UGRD HEAD COUNT			GRAD HEAD COUNT			FACULTY FTE		
DEPT	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3	YR 1	YR 2	YR 3
2804	40	50	60	35	45	55	13.00	14.00	15.00

Library

Acquisitions Needed:

none

Physical Facilities & Equipment

Existing Physical Facilities:

existing facilities adequate

Additional Facilities Required & Anticipated:

none

Other Support

Other Support Currently Available:

existing faculty and staffing is sufficient.

Other Support Needed over the Next Three Years:

none

Comments During Approval Process

7/26/2022 1:32 PM

WILLIAMSCINDY

Comments

Added a new Additional Information and Budget File to the Additional Info tab and replaced the Peer Comparison file per the request of Melanie Madden and the department.

7/29/2022 9:53 AM

MELANIECMADDEN

Comments

Per Elsa Morales, Pierre Deymier is former department head; proposal should be routed to Sammy Tin who has been department head since August of 2021. This form should be denied and resubmitted after Sammy Tin (netid: tin) is added as the department approver.

8/17/2022 4:45 PM

MELANIECMADDEN

Comments

Replaced Appendix A with updated file (with BE 220 included in CAD electives) and re-routed initial department approval to Dr. Sammy Tin per email from Elsa Morales sent 7-26-2022

8/25/2022 1:33 PM

TIN

Comments

Approved.

9/19/2022 10:49 AM

MELANIECMADDEN

Comments

Approved.

9/19/2022 4:05 PM

DBOCCELLI

Comments

Approved.

9/20/2022 12:29 PM

SHARONONEAL

Comments

After consulting with other faculty in the SIE Dept (Hannah Budinoff, Ricardo Valerdi, and Mohammed Shafae), the SIE Dept is fully supportive of this proposal/program.

9/20/2022 12:29 PM

SHARONONEAL

Comments

Approved.

10/12/2022 11:50 AM

MELANIECMADDEN

Comments

Updating Anticipated 1st Admission Term to Spring '23 since the start of Fall 22 has passed.
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NEW CERTIFICATE PROPOSAL

Note: New programs requiring a [program fee](#) must have the fee approved prior to implementation.

I. CERTIFICATE DESCRIPTION–

The University of Arizona College of Engineering is pleased to offer a new undergraduate certificate in Additive Manufacturing (AM). Additive Manufacturing (or 3-D Printing) has become an enabling product realization approach that provides fundamentally new opportunities for the rapid design and fabrication of parts used in applications ranging from aerospace and mechanics to biological systems and optics. Knowledge of AM methods and their application is fast becoming a critical element of engineering practice across multiple disciplines. The CoE AM certificate provides students (including degree-seeking, non-degree-seeking and non-traditional) with the foundational principles of AM processes and the computer-aided design capabilities necessary to implement these technologies. The certificate offers students an opportunity to address specific AM-relevant themes, drawing from a broad collection of elective course offerings, spanning multiple engineering disciplines, including the materials science of AM, systems-level integration of AM capabilities, process control in AM, and computational modeling. The AM certificate will offer students a unique opportunity to augment their existing educational background toward increased competitiveness in a manufacturing area with a critical role in the 4th industrial revolution.

II. NEED FOR THE CERTIFICATE/JUSTIFICATION -

There is broad regional, national and international interest in Additive Manufacturing processes, materials, and technologies. The need for AM-related educational programs to address key workforce needs now and into the future is great (e.g. <https://edtechmagazine.com/higher/article/2020/01/colleges-tailor-additive-manufacturing-curricula-demand-careers-perfcon>), leading to the development of AM or 3DP centers and educational programs both nationally and internationally. Within the US, established AM degree programs exist at, for example ASU, MIT, UTEP, Colorado School of Mines, Penn State, Case Western Reserve, University of Florida, Georgia Tech, and Missouri S&T illustrating the broad interest in the field and the need for career-relevant educational options.

In addition to degree-based curricula (e.g. majors, minors), new certificate options enable non-degree seeking students (including non-traditional students already in the workforce) to augment their expertise and career options. The prevalence of such certificate programs offered is limited however, enabling UA to take a regional lead in the development of an undergraduate-level certificate that would greatly broaden accessibility to non-degree-seeking students. Existing certificates (both graduate and undergraduate) offered in AM include:

- a. Colorado School of Mines (CSM) (Graduate Certificate) (https://online.mines.edu/advanced-manufacturing-systems-online/?gclid=CjwKCAjw5c6LBhBdEiwAP9eiG6bXQL8vTFJ_IXr2szvXfMQ6S86Qo--qUqjLVuMFzTUA7FN9IJUALBoC0fiQAvD_BwE);

- b. SME (Society of Manufacturing Engineers) – AM certification (vocational certification), (<https://www.sme.org/training/additive-manufacturing-certification/>)
- c. Texas A&M University (TAMU) AM Certificate Program – (<https://tees.tamu.edu/workforce-development/professional-education/additive-manufacturing-cert/index.html>)
- d. The Barnes Global Advisors/Purdue University AM Certificates (<https://www.barnesglobaladvisors.com/additive-manufacturing-certificate>)
- e. Penn State University – Additive Manufacturing and Design (Graduate Certificate), (<https://www.worldcampus.psu.edu/degrees-and-certificates/penn-state-online-additive-manufacturing-and-design-graduate-certificate/overview>)
- f. UCSD Extension – AM Certificate (<https://extension.ucsd.edu/courses-and-programs/additive-manufacturing>).
- g. UTEP – 3D Engineering and AM (Graduate Certificate (<http://catalog.utep.edu/grad/college-of-engineering/mechanical-engineering/grcertificate-3dam/>)

In addition to traditional academic institutions, certificates are also being offered through professional societies (see SME above), again indicating the strong need for such programs to address workforce development in the field. While we do find certificate activity in the SW USA region (e.g. CSM, UTEP, UCSD), there is, as yet, no certificate program (graduate or undergraduate) in AM offered within the Arizona University system. The University of Arizona would be the first to address this need in the state.

The Materials Science and Engineering Dept. at UA has initiated and led the development of the Additive Manufacturing Initiative (AMI – ami.arizona.edu) that includes faculty affiliates and research activities from across the University (including the Colleges of Engineering, Science, Optical Sciences, Architecture, Medicine, and the Lunar and Planetary Lab). Moreover, the Initiative is leading the development of a new state-wide partnership in AM with ASU and NAU. The focus on AM at UA has already led to the development and approval of a College of Engineering-wide AM minor, motivated by discussions with regional industrial partners (including Honeywell Aerospace, PADT, Raytheon) who recognize the need for workforce development in this rapidly evolving advanced manufacturing method and, indeed, who strongly support efforts in AM education and training through senior capstone project funding, for example. The proposed certificate will broaden the impact of AM-related courses within the CoE to enable access by non-degree seeking and non-traditional students. In addition to existing transfer opportunities with PCC's Engineering program, the AM certificate will also directly connect to the Applied Technology (AT) program at PCC, leveraging an established manufacturing-based curriculum and large-scale teaching facility.

This broad-based interest and support from the manufacturing community, the established minor curriculum offering at UA and the certificate programs developed regionally (e.g. CSM, UTEP) and nationally, provides the strong impetus to offer such an undergraduate certificate in AM. The certificate will provide a state-of-the-art educational and professional option with access for a broad range of participants in an area of significant impact in the engineering field as well as develop new interest and enhanced recruitment opportunities in the College.

III. PROGRAM AFFILIATION-

The proposed undergraduate certificate in AM will draw from course offerings now a part of the CoE undergraduate minor in Additive Manufacturing. Through the existing College-wide minor, a collaborative arrangement in which course offerings spanning multiple departments (i.e. Materials Science and Engineering, Systems and Industrial Engineering, Civil Engineering, Biosystems Engineering, Aerospace and Mechanical Engineering) are already active. Specific support from these departments (memos included in the proposal package) has been obtained for the certificate program as well.

IV. CERTIFICATE REQUIREMENTS– UNDERGRADUATE CERTIFICATE

Requirements should include sufficient units to provide a substantive program and an appropriate level of academic rigor and in no case be less than 12 units of credit.

Minimum total units required	12
Minimum upper division units	6
Total transfer units that may apply to the certificate. <i>Note: A minimum of six (6) units used to complete the certificate must be University credit.</i>	6
Pre-admissions expectations (i.e., academic training to be completed prior to admission)	<p>A high school diploma or equivalent is required for admission to an undergraduate certificate.</p> <p>Prior to admission, students must have completed at least 2 semesters of undergraduate-level general inorganic chemistry and one semester of calculus (GPA of at least 2.5), their equivalents, or by demonstration of equivalent competencies (e.g. Advanced Placement, other placement examinations).</p>
Certificate requirements. List all certificate requirements including core and electives. Courses listed must include course prefix, number, units, and title. Mark new coursework (New) . Include any limits/restrictions needed. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	<p><u>Select 2 anchor courses from the following:</u></p> <p>ONE from this list:</p> <p>MSE 222 – Introduction to Materials Science and Engineering I MSE 331r – Fundamentals of Materials for Engineers</p> <p>ONE from this list:</p> <p>MSE 440 – Metal Additive Manufacturing AME 410 – Introduction to Additive Manufacturing SIE 481 – Design for Additive Manufacturing</p> <p>Select 1 CAD-related course:</p> <p>BE/ENGR 221 – Introduction to Computer Aided Design BE 220 – Engineering Graphics and Design with Auto Cad</p>

	<p>AME 211 – Computer Aided Drafting and Manufacturing (or PCC transfer (CAD270, MAC155, and MAC257 (combined)))</p> <p>Elective (3 credits): choose ONE from following course listing</p> <p><u>Existing UA Courses:</u></p> <p>MSE 220: 3-D Printing and the Environment MSE 460: Materials Science of Polymers SIE 406: Quality Engineering SIE 383: Integrated Manufacturing Systems AME 410: Introduction to Additive manufacturing AME 463: Finite Element Analysis with ANSYS CE 402: Introduction to Finite Element Methods MSE 414: Solidification of Casting MSE 455: Physical metallurgy and processes of alloys MSE 440: Metal Additive Manufacturing SIE 481: Design for Additive Manufacturing</p> <p><u>UA Courses Envisioned or Under Development:</u></p> <p>SIE XXX: Process Modeling and Digital Manufacturing (under development) ENGR 2XX: The Fourth Industrial Revolution MSE 2XX: Metallurgical Processing Methods</p>
<p>Internship, practicum, applied course requirements (Yes/No). If yes, provide description.</p>	<p>No</p>
<p>Any double-dipping restrictions (Yes/No)? If yes, provide description.</p> <p>*A maximum of 6 units may double-dip with a degree requirement (major, minor, General Education) or second certificate.</p>	<p>Students may apply 6 units towards major or minor.</p>
<p>Additional requirements (provide description)</p>	<p>No</p>

V. CURRENT COURSES–

Course prefix and number (include cross-listings)	Units	Title	Pre-requisites	Modes of Delivery (online, in-person, hybrid)	Campus and Location Offered	Dept signed party to proposal? (Yes/No)
MSE 222	3	Introduction to Materials Science and Engineering I	<i>Chem 151; MSE 110 or Chem 152; Math 122B or Math 125</i>	In-person; online	UA Main	Yes
MSE 331r	3	Fundamentals of Materials for Engineers	<i>Chem 151 and PHYS 103</i>	In-person; online	UA Main	Yes
MSE 220	3	Make it...Green! 3-D Printing and the Environment	none	In-person	UA Main	Yes
AME 410	3	Introduction to Additive Manufacturing	<i>AME 313, MSE 331r, and (BE 221 or AME 211)</i>	In-person	UA Main	Yes
SIE 383	3	Integrated Manufacturing Systems	<i>CHEM 103A, PHYS 141, CAD Drawing experience</i>	In-person, online	UA Main	Yes
BE/ENGR 221	3	Introduction to Computer Aided Design	None	In-person	UA Main	Yes
BE 220	3	Engineering Graphics and Design with Auto Cad	None	In-person	UA Main	Yes
AME 211 (Pima CC transfer (CAD270, MAC155, and MAC257 (combined)))	3	Computer Aided Drafting and Manufacturing	<i>Math 122B</i>	In-person	UA Main	Yes
MSE 460	3	Materials Science of Polymers	<i>MSE 223R or MSE 331R</i>	In-person, online	UA Main	Yes
SIE 406	3	Quality Engineering	<i>Adv. Standing: Engineering, SIE 305</i>	In-person, online?	UA Main	Yes
AME 463	3	Finite Element Analysis with ANSYS	<i>AME 301 and AME 302 and (AME 324A or CE 215)</i>	In-person	UA Main	Yes
CE 402	3	Introduction to Finite Element Methods	<i>Adv Standing: Engineering. CE 303</i>	In-person	UA Main	Yes
MSE 414	3	Solidification of Casting	<i>AME 432 or CHEE 305, MSE 415; MSE 331r or MSE 110</i>	In-person	UA Main	yes
MSE 455	3	Physical metallurgy and processes of alloys	<i>MSE 223R or MSE 331R</i>	In-person	UA Main	Yes
MSE 440	3	Metal Additive Manufacturing	<i>MSE 110, MSE 222 or MSE 331R</i>	In-person	UA Main	Yes

SIE 481	3	Design for Additive Manufacturing.	<i>Advanced Standing; some experience in AM and CAD recommended</i>	In-person	UA Main	Yes
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VI. CONTACTS AND ADMINISTRATION

UNDERGRADUATE (delete if n/a)

a. List the name and contact information for the primary point of contact for the certificate:

Elsa Morales – Academic Program Coordinator, MSE, elsam@email.arizona.edu

b. List the name and contact information for the person or persons who will serve in the role of Director of Undergraduate Studies (DUS) for the certificate (this is not always the same as the DUS for affiliated programs or head of the managing academic unit.):

Prof. B.G. Potter, Professor and Associated Head, MSE

c. If known, list the members of the certificate oversight committee for this certificate. Note: undergraduate certificate oversight committees shall consist of a minimum of 3 members, 2 of which are faculty and at least one of the 2 is participating faculty in the certificate program. The oversight committee is responsible for 1) qualifications of participating faculty, 2) coordination of admissions recommendations with the Office of Admissions, and 3) curricular changes:

- Prof. B.G. Potter, MSE
- Prof. K. Muralidharan, MSE
- Prof. A. Wessman, MSE
- Prof. H. Budinoff, SIE

VII. REQUIRED SIGNATURES

Program Director/Main Proposer: Barrett Potter, Professor and Associate Department Head

Program Director/Main Proposer signature:

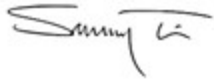
Date: 12/17/2021



Department Head: Sammy Tin, Professor and Department Head

Department Head's signature:

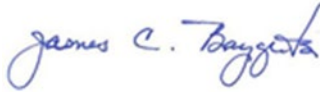
Date: 12/17/2021



Associate/Assistant Dean: James C. Baygents, Associate Dean, Academic Affairs, College of Engineering

Associate/Assistant Dean's signature:

Date: 18 July 2022



Dean (print name):

Dean's signature:

Date:

For use by Curricular Affairs (Undergraduate):

Committee	Approval date
APS	
Undergraduate Council	
Undergraduate College Academic Administrators Council	



BUDGET PROJECTION FORM

Note - the proposed certificate provides an opportunity for non degree seeking students and students across the College of Engineering to collect existing courses related to additive manufacturing into a new certificate focus. As such, no additional budget is required to provide this opportunity. While we do anticipate that having such a certificate offering will be helpful for recruitment, we will be drawing on existing College of Engineering recruitment for the existing major programs and departments rather than initiating new activities focusing only on this certificate. Given this background, it is not clear how best to respond to the request for budget projections.

Name of Proposed Program or Unit: Additive Manufacturing Undergraduate Certificate

Budget Contact Person: Elsa Morales/BG Potter	Projected		
	1st Year 20__ - 20__	2nd Year 20__ - 20__	3rd Year 20__ - 20__
METRICS			
Net increase in annual college enrollment UG	20	30	40
Net increase in college SCH UG	120	180	240
Net increase in annual college enrollment Grad			
Net increase in college SCH Grad			
Number of enrollments being charged a Program Fee			
New Sponsored Activity (MTDC)			
Number of Faculty FTE			
FUNDING SOURCES			
<u>Continuing Sources</u>			
UG AIB Revenue	103,800	155,700	207,600
Grad AIB Revenue			
Program Fee Revenue (net of revenue sharing)			
F and A AIB Revenues			
Reallocation from existing College funds (attach description)			
Other Items (attach description)			
Total Continuing	\$ 103,800	\$ 155,700	\$ 207,600
<u>One-time Sources</u>			
College fund balances			
Institutional Strategic Investment			
Gift Funding			
Other Items (attach description)			
Total One-time	\$ -	\$ -	\$ -
TOTAL SOURCES	\$ 103,800	\$ 155,700	\$ 207,600
EXPENDITURE ITEMS			
<u>Continuing Expenditures</u>			
Faculty			
Other Personnel			
Employee Related Expense			
Graduate Assistantships			
Other Graduate Aid			
Operations (materials, supplies, phones, etc.)			
Additional Space Cost			
Other Items (attach description)			
Total Continuing	\$ -	\$ -	\$ -
<u>One-time Expenditures</u>			
Construction or Renovation			
Start-up Equipment			
Replace Equipment			
Library Resources			
Other Items (attach description)			
Total One-time	\$ -	\$ -	\$ -
TOTAL EXPENDITURES	\$ -	\$ -	\$ -
Net Projected Fiscal Effect	\$ 103,800	\$ 155,700	\$ 207,600



New Academic Program PEER COMPARISON

Select three peers (if possible/applicable) for completing the comparison chart from [ABOR-approved institutions](#), [AAU members](#), and/or other relevant institutions recognized in the field. The comparison programs are not required to have the same degree type and/or title as the proposed UA program. Information for the proposed UA program must be consistent throughout the proposal documents. Minors and Certificates may opt to include only 2 peer comparisons.

Program name, degree, and institution	Proposed UA Program: Undergraduate Certificate in Additive Manufacturing	Peer 1 Additive Manufacturing Certificate: Texas A&M Engineering Experiment Station	Peer 2 AM Certificate for Engineers: TBGA/Purdue University	Peer 3 Additive Manufacturing Certificate: UCSD extension
Current number of students enrolled		Estimate: 170	Estimate: 120	Estimate: 60
Program Description	The University of Arizona College of Engineering is pleased to offer a new undergraduate certificate in Additive Manufacturing (AM). Additive Manufacturing (or 3-D Printing) has become an enabling product realization approach that provides fundamentally new opportunities for the rapid design and fabrication of parts used in applications ranging from aerospace and mechanics	The module-based additive manufacturing certificate program addresses four key areas: <ol style="list-style-type: none"> 1. Additive manufacturing fundamentals 2. Product and process design (including design for additive manufacturing) 3. Additive manufacturing materials 	The program is for working professionals or students who want to know more about additive manufacturing from both a technical and business mindset. The certificates will give students an introduction to the basic principles. By achieving the certificate, the student will have demonstrated the basic knowledge of what AM is, how it works, the different types of AM materials, the	Required Courses: SolidWorks for 3D printing Additive Manufacturing Technologies Geometric Dimensioning & Tolerancing (GD&T) Fundamentals of CAD with CATIA V5 Fundamentals of Industrial Robotics

	<p>to biological systems and optics. Knowledge of AM methods and their application is fast becoming a critical element of engineering practice across multiple disciplines. In an effort to address this need, the CoE AM certificate provides students (including degree-seeking, non-degree-seeking and non-traditional) with the foundational principles of AM processes and the computer-aided design capabilities necessary to implement these technologies. In this way, the certificate will enhance educational opportunities for existing students, offer a path toward expertise development and employment enhancement for industrial participants and an overall factor increasing degree program recruitment in the College of Engineering. The certificate offers students</p>	<p>4. <u>Quality and cost considerations</u></p>	<p>importance of design for additive manufacturing and/or business and economics principles.</p>	
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	<p>an opportunity to address specific AM-relevant themes, drawing from a broad collection of elective course offerings, spanning multiple engineering disciplines, including the materials science of AM, systems-level integration of AM capabilities, process control in AM, and computational modeling. In this regard, the AM certificate will offer students a unique opportunity to augment their existing educational background toward increased competitiveness in a manufacturing area with a critical role in the 4th industrial revolution.</p>			
Target Careers	Process and Production Engineers, Manufacturing Design	Process and Production Engineers, Manufacturing Design	Process and Production Engineers, Manufacturing Design	Process and Production Engineers, Manufacturing Design
Minimum # of units required	12	Module based, must complete all four above modules	Students take 3 courses that are in turn broken up into learning modules: AM Essentials, AM Technology and Materials, AM Design	Required Course described above.
Special requirements to declare/gain admission?	Students are assumed to have successfully completed foundation,	No	No	No

(i.e. pre-requisites, GPA, application, etc.)	freshman-level coursework consistent with coursework pre-requisites.			
Internship, practicum, or applied/experiential requirements? If yes, describe.	No	No	No	No

Additional questions:

1. How does the proposed program align with peer programs? Briefly summarize the similarities between the proposed program and peers, which could include curriculum, overall themes, faculty expertise, intended audience, etc.

The proposed program is similar in several characteristics to the peer programs selected. In this case, the programs include design, technical and scientific foundations, and address AM-specific technologies and their application. Moreover, peer programs are focused on undergraduate or continuing education (nontraditional) students with interest in expanded exposure and technical training in additive manufacturing methods and their impact on existing manufacturing processes.

2. How does the proposed program stand out or differ from peer programs? Briefly summarize the differences between the proposed program and peers, which could include curriculum, overall themes, faculty expertise, intended audience, etc.

The proposed program at UA is differentiated by the breadth of scope offered. While the UA program offers required curriculum elements addressing core issues in AM that are also addressed by the peer programs, the proposed program provides an opportunity to tailor the certificate toward sub-specialties of interest to the student, including materials for AM and computational methods for AM. Moreover, the UA certificate will be expanded in the near-term to include biomedical-based and AM-in-architecture offerings as AM-related curriculum is added across the College. The program is thus designed to allow the ready accommodation of new AM foci and industrial relevance as the field evolves. Finally, inherent in the certificate structure is the increased opportunity for the transfer of course credits from Pima Community College (building from the existing AM minor) as a means to strengthen regional participation in advanced manufacturing workforce training for state-wide stakeholders.

3. How do these differences make this program more applicable to the target student population and/or a better fit for the University of Arizona?

The proposed certificate leverages a newly established programmatic focus in the College of Engineering in Additive Manufacturing. The Additive Manufacturing Initiative (AMI) began 3 years ago and has focused on the integration of AM-related programs and curriculum College-wide (through new program development and faculty hiring) in addition to the development of numerous industrial partnership relationships in AM. The certificate is wholly consistent with the interests and needs of these stakeholders and represents a natural extension of the existing CoE minor in AM while recognizing the limited access to such an AM-focused educational program for nontraditional or non-degree seeking students.

The UA CoE certificate will be the only undergraduate certificate in AM in the state of Arizona and, moreover, it will be one of only a limited number of undergraduate-level programs of its type in the nation. A majority of AM certificate programs in the US are focused at the graduate level. A focus on CoE undergraduate and non-degree seeking, industrial participants, coupled with the opportunity for increased access afforded to the local community college students, will enable the proposed program to significantly impact regional and state industries in terms of workforce development and retention while building a workforce capable of meeting the evolving challenges in advance manufacturing for increased competitiveness.



THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING

Biosystems Engineering

November 18, 2021

Prof. B.G. Potter, Jr.
Materials Science and Engineering Dept.

Dear Dr. Potter,

Thank you for your recent message concerning the development of a new College of Engineering Undergraduate Certificate in Additive Manufacturing. As a home department for one or more courses that have been included in the initial curriculum listing for the Certificate, this letter serves to confirm our support for this new curriculum opportunity. Further, the courses involved in the Certificate are regularly offered as part of our existing curriculum and seats are generally available in these classes.

Sincerely,

K. L. Farrell-Poe

Kathryn L. Farrell-Poe, PhD
Head, Professor, & Specialist
Biosystems Engineering Department



THE UNIVERSITY OF ARIZONA

College of Engineering

November 18, 2021

Prof. B.G. Potter, Jr.
Materials Science and Engineering Dept.

Dear B.G.

Thank you for your recent message concerning the development of a new College of Engineering Undergraduate Certificate in Additive Manufacturing. As a home department for one or more courses that have been included in the initial curriculum listing for the Certificate, this letter serves to confirm our support for this new curriculum opportunity. Further, the courses involved in the Certificate are regularly offered as part of our existing curriculum and seats are generally available in these classes.

Sincerely,

Peiwen (Perry) Li
Department Head
Department of Aerospace and Mechanical Engineering
The University of Arizona
Peiwen@arizona.edu



THE UNIVERSITY OF ARIZONA

College of Engineering

November 18, 2021

Prof. B.G. Potter, Jr.
Materials Science and Engineering Dept.

Dear B.G.

Thank you for your recent message concerning the development of a new College of Engineering Undergraduate Certificate in Additive Manufacturing. As a home department for one or more courses that have been included in the initial curriculum listing for the Certificate, this letter serves to confirm our support for this new curriculum opportunity. Further, the courses involved in the Certificate are regularly offered as part of our existing curriculum and seats are generally available in these classes.

Sincerely,

Dominic Boccelli
Professor and Department Head
Civil and Architectural Engineering and Mechanics
University of Arizona



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Systems and Industrial Engineering Dept.