Proposed Title: Master of Science in Mechanical Engineering
Proposed Effective Date: Fall 2018

Need and Justification

There is a shortage of Engineers with advance degrees in the United States [1]. For the eighth consecutive year, ManpowerGroup identified engineers as one of the top 10 hardest jobs to fill [2]. ManpowerGroup is a world leader in innovative workforce solutions that surveys the demand and supply relationship across a wide range of industries. Across all industries, 32% of United States employers say they struggle to fill positions. However, 82% of employers who hire engineers struggle to fill open positions, with Mechanical Engineering ranking first in the shortage occupation list.

To create a vision of Mechanical Engineering education and research for 2030, the National Science Foundation sponsored several workshops to explore necessary transformative change in Mechanical Engineering in the United States [3]. One of the workshop's recommendations was masters degree programs should introduce engineering as a profession, and become the requirement for professional practice. By increasing the depth of engineering education with a Master of Science degree in Mechanical Engineering, Arkansas Tech University helps to address the shortage of advanced degrees in engineering in the United States.

To prepare our graduates for a successful competition and employment in the local, regional, national and international job markets, the program is developed with recent baccalaureate graduates, as well as experienced engineers in mind. The program accommodates the needs of working full-time engineers who plan to continue and update their knowledge. This is achieved through this program's carefully designed curriculum which aims at dissemination of recent research findings, uses advanced engineering tools, and introduces state-of-the-art science on a number of rapidly growing areas of Mechanical Engineering.

Enrollment Projection

Mechanical Engineering is the fastest growing field of engineering in the United States when it comes to student enrollment. Figure 1 shows the outcome of a study conducted by American Society of Engineering Education to compare the number of enrolled Master's students in different fields of engineering during the past 10 years [4]. As the figure indicates, the number of enrolled students is increasing from 4,700 in year 2006 to 7,100 in 2016. This shows an overall enrollment increase of 55% in American Colleges and Universities.

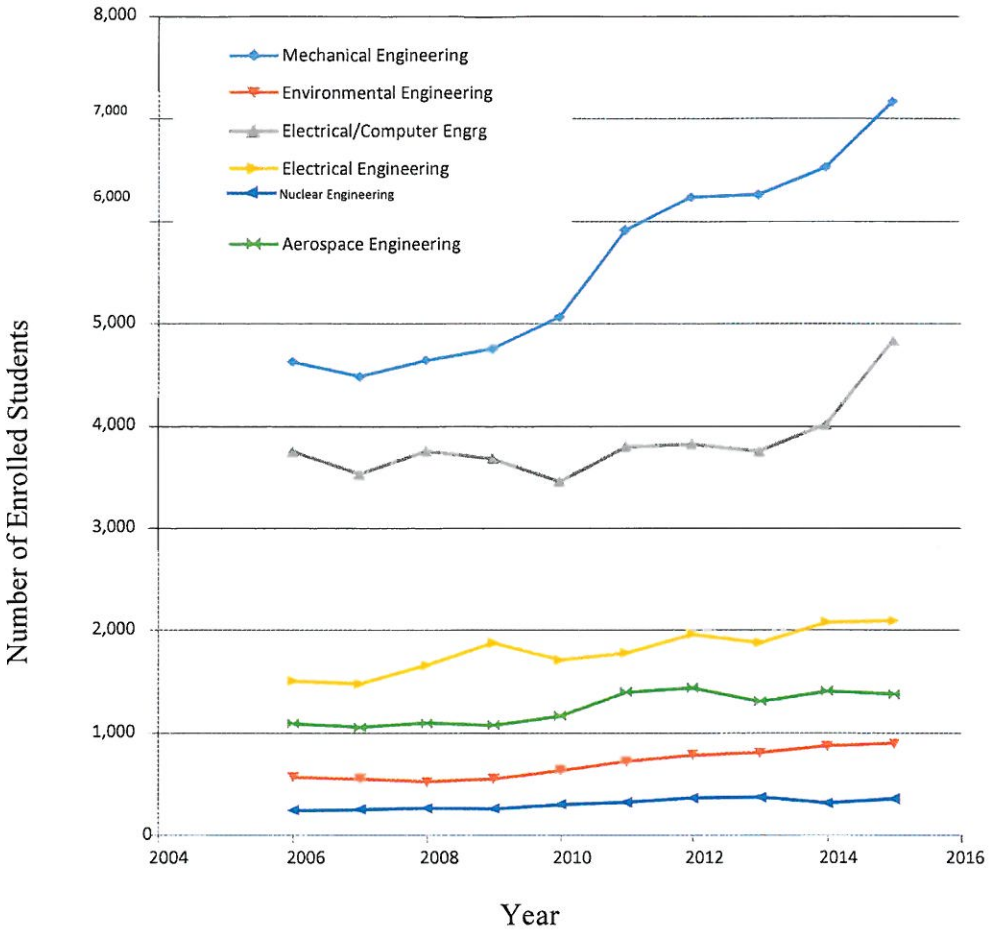

Figure 1: Enrollment increase of master's students in different fields of engineering [4]

Table 1 highlights student to faculty ratios of different Colleges and Universities in the United States [4]. The first column shows different United States Universities that reported their master's enrollment publicly. The second column, Award-Faculty Ratio, reports the number of master's degrees awarded per faculty member, with schools ranked in descending order.

To perform an enrollment projection, University of Wisconsin-Stout (UWS) is used as the basis for analysis, because of its similarities with Arkansas Tech University. UWS is categorized as a Master's College and University according to Carnegie Classification, and it is a regional public University with a student enrollment of 9,500. The Award-Faculty ratio for UWS is 7.5.

Assuming the same Award-Faculty ratio for Arkansas Tech University, and having 10 faculty members in the department of Mechanical Engineering, it is expected to enroll 75 master's students in the coming 5 years. Table 2 shows how the department plans to reach this number in the coming 5 years.

Table 1: Master's Degrees Awarded & Student Enrollment-to-Faculty Ratios, 2015 [4]

US Universities	Award-Faculty Ratio
Tuskegee University	33.00
Trine University	23.00
Wilkes University	15.00
Bucknell University	8.88
University of Wisconsin-Stout	7.50
Princeton University	5.74
Howard University	5.63
Indiana University-Purdue University Fort Wayne	4.75
University of California-Merced	3.58
Alabama A&M University	3.20
University of Maine	2.43
University of the District of Columbia	2.40
Milwaukee School of Engineering	2.35
Kettering University	2.16
Widener University	1.92
Clarkson University	1.87
Alfred University-NY State College of Ceramics	1.82
Rose-Hulman Institute of Technology	1.78
University of Alaska Fairbanks	1.67
Prairie View A&M University	1.50
SUNY-College of Environ. Science and Forestry	1.40
Seattle University	1.30
Tennessee State University	1.26
California Institute of Technology	1.24
Montana Tech of the University of Montana	1.23
Texas A&M University – Kingsville	0.09
Stevens Institute of Technology	0.09
University of Bridgeport	0.07
U.S. Merchant Marine Academy	0.01

Table 2: Details of master's enrollment projection in the department of Mechanical Engineering

Year	2018	2019	2020	2021	2022
Student enrollment	15	30	45	60	75

Curriculum Outline

Currently the Department offers a Master of Engineering in Mechanical Engineering program that requires the completion of 36 credit hours. The emphasis of the existing program is a general master's degree where the students take 6 credit hours of Project Management and Organizational Communication, and 6 credit hours of Mathematics as common courses. The remaining 24 credit hours are weighted more towards Nuclear Engineering related topics.

The new MS in Mechanical Engineering requires the completion of a minimum of 30 credit hours. There are three program choices: coursework (non-thesis), research project (non-thesis), or thesis options. It is expected that the students complete their degree between 3 (if the students take summer courses) to 4 semesters. The program addresses the current and future demands in emerging areas of Mechanical Engineering. These are Nanotechnology and MEMS, and Energy Systems (with emphasis on Renewable energy).

To attract and encourage qualified Arkansas Tech's undergraduate senior students to obtain an MS degree in Mechanical Engineering, a Fast Track program is proposed for those who have a CGPA of 3.5 and higher. Fast track students can take up to 6 graduate level credits (one 5000, and one 6000 level course) during their senior year baccalaureate degree that will be counted toward their master's degree. This allows our highly qualified BS students to remain in Tech and earn a combined BS and MS degree within 5 years.

Resources Needed

The school has a dedicated space (Corley 127) equipped with computers that can accommodate 12 Graduate Assistants (GA) involved in research with faculty. Given the fact that more new master students will be involved in research and teaching activities, extra office space is needed. Based on the enrollment/admission projection, nearly 18 desks/computers are recommended by the end of the 5th year.

Extra lab space and equipment are needed for faculties who conduct experimental work with their graduate students (thesis and project option). Graduate student space allocation is projected to gradually increase to accommodate graduate activities. No additional library resources are expected, and the program requires no support courses from other programs in the university.

Note that this Master of Science in Mechanical Engineering (MSME) program is to replace our Master of Engineering in Mechanical Engineering (MEME). As such, the resource projection described here is the same as the existing and growing MEME degree. Therefore, no additional resources are needed beyond and above what is currently needed for the growth of the existing MEME program.

Estimated Budget

Enrollment data of Table 2 are used to estimate the budget. To simplify the estimation, an average of 45 students per year is used for a conservative steady-state average yearly enrolled student number. To maintain a quality program and attract top students 10 GA positions (22%) are needed. All enrolled students conservatively will pay in-state tuition ($274 per course credit hour based on 2016-2017 university fees). Below is a one year steady-state cost analysis.

1-Year income

45 students * 30 credits * $274 per credit hour	$369,900

1-Year cumulative expenses

10 GAs * 30 credits * $274 per credit hour	$82,200
10 GAs * $6,000 stipend	$60,000
Lab equipment ($90K) amortized over 5 years	$18,000
18 computers and desks ($1,400 per unit) amortized over 5 years	$5,040
Total	$165,240

Net 1-year revenue

The 1-year net revenue is estimated to be $204,660 ($369,900 - $165,240).

References

[1] Stevenson, H.J., 2014. Myths and motives behind STEM (science, technology, engineering, and mathematics) education and the STEM-worker shortage narrative. *Issues in Teacher Education*, *23*(1), p.133.

[2] ManpowerGroup, URL: http://www.manpowergroup.com/workforce-insights, Last accessed: April 7, 2017.

[3] Narional Science Foundation, 5XME workshop. "Transforming Mechanical Engineering Education and Research in the USA", URL: http://www-personal.umich.edu/~ulsoy/5XME.htm, Last accessed: April 7, 2017.

[4] Yoder, B., L., 2015. Engineering by the Number, American Society of Engineering Education (ASEE), www.asee.org/colleges, Last accessed: April 7, 2017.

Proposed Title: Master of Science in Electrical Engineering
Proposed Effective Date: Fall 2018

Need and Justification

There is a shortage of Engineers with advance degrees in the United States [1]. For the eighth consecutive year ManpowerGroup identified engineers as one of the top 10 hardest jobs to fill [2]. ManpowerGroup is a world leader in innovative workforce solutions that surveys the demand and supply relationship across a wide range of industries. Across all industries, 32% of United States employers say they struggle to fill positions. However, 82% of employers who hire engineers struggle to fill open positions, with Electrical Engineering ranking second in the shortage occupation list.

According to Bureau of Labor Statistics, Occupational Outlook Handbook, 2016-17 Edition, job growth for electrical and electronics engineers will occur largely in engineering services firms, because more companies are expected to cut costs by contracting their engineering services rather than directly employing engineers [3]. These engineers also will be in demand to develop sophisticated consumer electronics. The rapid pace of technological innovation and development will likely drive demand for electrical and electronics engineers in research and development, an area in which engineering expertise will be needed to develop distribution systems related to new technologies. These engineers will play key roles in new developments having to do with solar arrays, semiconductors, and communications technologies.

To prepare our graduates for a successful competition and employment in the local, regional, national and international job markets, the program is developed with recent baccalaureate graduates, as well as experienced engineers in mind. The program accommodates the needs of working full-time engineers who plan to continue and update their knowledge. This is achieved through this program's carefully designed curriculum which aims at dissemination of recent research findings, uses advanced engineering tools, and introduces state-of-the-art science on a number of rapidly growing areas of Electrical Engineering.

Enrollment Projection

Electrical Engineering is among the fastest growing fields of engineering in the United States when it comes to student enrollment. Figure 1 shows the outcome of a study conducted by American Society of Engineering Education to compare the number of enrolled Master's students in different fields of engineering during the past 10 years [4]. As the figure indicates, the number of enrolled students is increasing from 1,600 in year 2006 to 2,100 in 2016. This shows an overall enrollment increase of 76% in American Colleges and Universities in the field of Electrical Engineering.

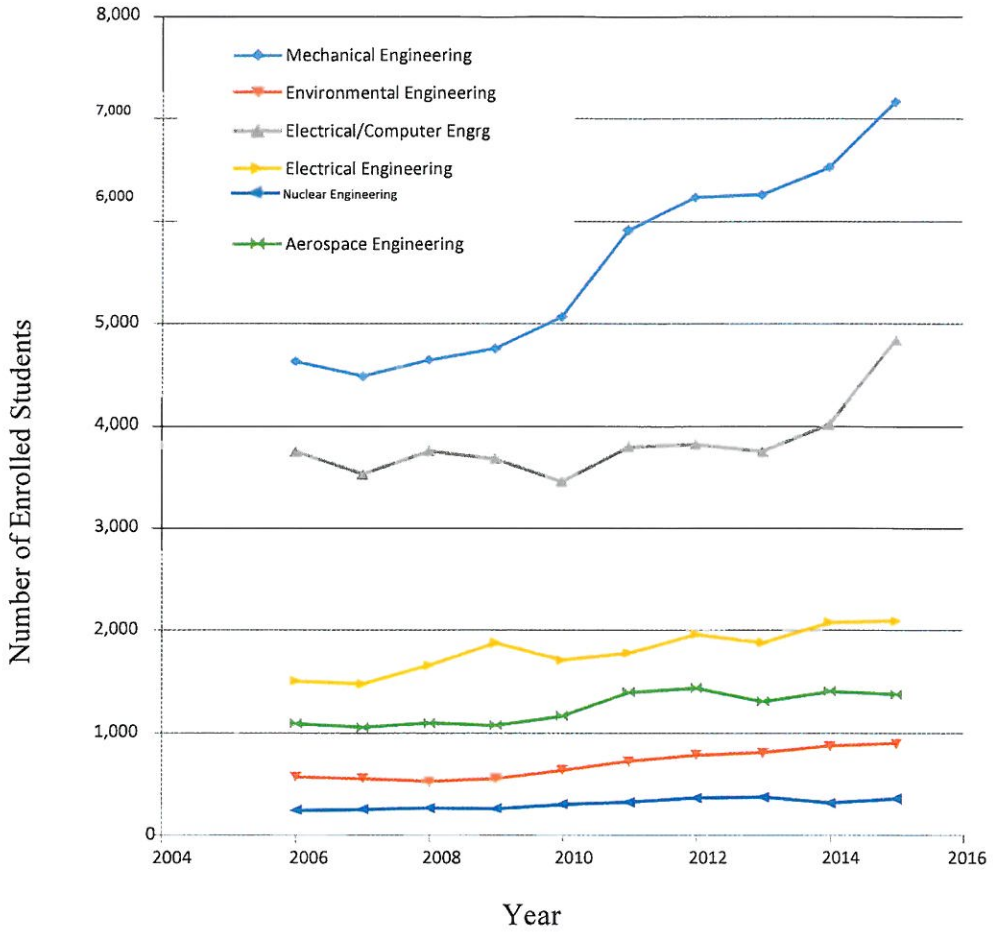

Figure 1: Enrollment increase of master's students in different fields of engineering [4]

Table 1 highlights student to faculty ratios of different Colleges and Universities in the United States [4]. The first column shows different United States Universities that reported their master's enrollment publicly. The second column, Award-Faculty Ratio, reports the number of master's degrees awarded per faculty member, with schools ranked in descending order.

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Assuming the same Award-Faculty ratio for Arkansas Tech University, and having 10 faculty members in the department of Electrical Engineering, it is expected to enroll 75 master's students in the coming 5 years. Table 2 shows how the department plans to reach this number in the coming 5 years.

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University of Alaska Fairbanks	1.67
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SUNY-College of Environ. Science and Forestry	1.40
Seattle University	1.30
Tennessee State University	1.26
California Institute of Technology	1.24
Montana Tech of the University of Montana	1.23
Texas A&M University – Kingsville	0.09
Stevens Institute of Technology	0.09
University of Bridgeport	0.07
U.S. Merchant Marine Academy	0.01

Table 2: Details of master's enrollment projection in the department of Electrical Engineering

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Note that this Master of Science in Electrical Engineering (MSEE) program is to replace our Master of Engineering in Electrical Engineering (MEEE). As such, the resource projection described here is the same as the existing and growing MEEE degree. Therefore, no additional resources are needed beyond and above what is currently needed for the growth of the existing MEEE program.

Estimated Budget

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[2] ManpowerGroup, URL: http://www.manpowergroup.com/workforce-insights, Last accessed: April 7, 2017.

[3] Occupational Outlook Handbook, United States Department of Labor, URL: https://www.bls.gov/ooh/about/occupational-information-included-in-the-ooh.htm, Last accessed: April 7, 2017.

[4] Yoder, B., L., 2015. Engineering by the Number, American Society of Engineering Education (ASEE), www.asee.org/colleges, Last accessed: April 7, 2017.

Pat Chronister

From: Pat Chronister
Sent: Tuesday, July 25, 2017 8:36 AM
To: Turaj Ashuri
Cc: Douglas Barlow; Patricia Buford; Bruce Chehroudi; Edward Greco
Subject: MS EE and ME white papers
Attachments: MS EE White Paper Fall 2018_Rev01.pdf; MS Mech White Paper Fall 2018_Rev01.pdf

Dr. Ashuri,

After speaking with Dr. Abdelrahman, you have his permission to proceed with development of the program proposals for both the MSEE and the MSME. However, please understand that permission to develop the program proposals does not guarantee final approval by the administration as your final program proposals will also be subject to review. In addition, the actual enrollment in the two programs, once approved, will determine the actual number of graduate assistantships available and any other available funding.

Thanks,
Pat

From: Turaj Ashuri
Sent: Friday, July 21, 2017 5:55 PM
To: Pat Chronister <pchronister@atu.edu>
Cc: Douglas Barlow <dbarlow@atu.edu>; Patricia Buford <pbuford@atu.edu>; Bruce Chehroudi <bchehroudi@atu.edu>; Edward Greco <cgreco@atu.edu>
Subject: RE: MS EE and ME white papers

Dear Ms. Chronister,

Please find attached the updated Master of Science in Electrical and Mechanical Engineering white papers for the Fall 2018.

We hope to have it approved quickly to allow us working on the details of the program.

Thank you,
Turaj

From: Turaj Ashuri
Sent: Thursday, July 20, 2017 4:24 PM
To: Douglas Barlow <dbarlow@atu.edu>; Patricia Buford <pbuford@atu.edu>; Bruce Chehroudi <bchehroudi@atu.edu>; Edward Greco <cgreco@atu.edu>
Subject: MS EE and ME white papers

Dear all,

Per request of academic affairs, I updated the two new MSc engineering white papers, and excluded the two new faculties we requested.

Please let me know if you have any comments before 4 PM tomorrow.

Thank you,
Turaj

From: Pat Chronister
Sent: Friday, July 7, 2017 8:34 AM
To: Turaj Ashuri <tashuri@atu.edu>
Cc: Douglas Barlow <dbarlow@atu.edu>; Patricia Buford <pbuford@atu.edu>; Bruce Chehroudi <bchehroudi@atu.edu>; Edward Greco <cgreco@atu.edu>
Subject: Re: MS Mech - White paper

Dr. Ashuri,

My understanding is that the original proposal included the addition of several new faculty. This is the part that is the issue.We understand that ultimately more faculty will hopefully be needed if the programs are as successful as we hope.

If the white papers are rewritten to include no new resources, then I think they could be resubmitted and possibly approved fairly quickly.

Thanks,
Pat

From: Turaj Ashuri
Sent: Thursday, July 6, 2017 10:49:16 PM
To: Pat Chronister
Cc: Douglas Barlow; Patricia Buford; Bruce Chehroudi; Edward Greco
Subject: Re: MS Mech - White paper

Dear Ms. Chronister,

Could you please provide us with an update on the status of the new Master of Science white papers Dean Barlow submitted few months ago (the new MS programs for the fall 2018)? We also would like to know what would be the next steps in the process to allow us preparing the required documents, and their corresponding deadlines.

Thank you,
Turaj Ashuri

From: Douglas Barlow
Sent: Friday, April 7, 2017 5:39 PM
To: Pat Chronister <pchronister@atu.edu>
Cc: Patricia Buford <pbuford@atu.edu>; Bruce Chehroudi <bchehroudi@atu.edu>; Turaj Ashuri <tashuri@atu.edu>
Subject: MS Mech

Pat
One more; three to go.
Neal

Dr Neal Barlow
Dean, Engineering and Applied Sciences

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