4-17-2015

SR-14-15-38

Marshall University

ACADEMIC PLANNING COMMITTEE
RECOMMENDATION

SR-14-15-38

Recommends that the Intent to Plan for the Bachelor of Science in Mechanical Engineering be approved.

RATIONALE:

The proposed degree program would be a valuable addition to the university program offerings.

FACULTY SENATE CHAIR:

APPROVED BY THE FACULTY SENATE: Larry Stickler DATE: 4/17/2015

DISAPPROVED BY THE FACULTY SENATE: _____ DATE: _____

UNIVERSITY PRESIDENT:

APPROVED: Kay E. Whitt DATE: 6/16/15

DISAPPROVED: _____ DATE: _____

COMMENTS: _____

MINUTES

ACADEMIC PLANNING COMMITTEE

February 26, 2015 – March 24, 2015, Electronic Meeting

MEMBERS PRESENT: Mindy Armstead, Tim Balch, Dallas Brozik, Andrew Burch, Robert Deal, Aley El-Shazly, Mary Kathryn Gould, Hyoil Han, Christine Ingersoll, Robert Marsh, Alex Parlock, Inder Sehgal.

EX-OFFICIO MEMBERS PRESENT: Ronald Bieniek, Robert Bookwalter, Monica Brooks, Haiyang Chen, Teresa Eagle, Michael McGuffey, Gayle Ormiston, David Pittenger, Michael Prewitt, Mary Beth Reynolds, Joseph Shapiro, Charles Somerville, Donald Van Horn, Kevin Yingling, Wael Zatar.

The committee met electronically to review the Intent to Plan for the Bachelor of Science in Mechanical Engineering. Suggestions were made that were incorporated into the Intent to Plan, and the revised version was approved.

Respectfully Submitted,
Christine Ingersoll

_____
Christine Ingersoll, Recording Secretary

MINUTES READ: Larry Stickler DATE: 6/11/2015
Faculty Senate Chair

INTENT TO PLAN

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING –BSME

MARSHALL UNIVERSITY ADMINISTRATIVE UNIT:

THE WEISBERG DIVISION OF ENGINEERING

COLLEGE OF INFORMATION TECHNOLOGY AND ENGINEERING

PROPOSED IMPLEMENTATION DATE: FALL 2015

January 23, 2015

Intent to Plan
Degree: Bachelor of Science-Mechanical Engineering (BSME)
Major: Mechanical Engineering

Marshall University Administrative Unit:
The Weisberg Division of Engineering, College of Information Technology and Engineering
Proposed Implementation Date: Fall 2015

Brief Summary Statement:

This is an Intent to Plan for a Bachelor of Science in Mechanical Engineering (BSME) by the Weisberg Division of Engineering of the College of Information Technology and Engineering (CITE) to graduate mechanical engineers for meeting West Virginia's increasing technological demands. Graduates of this Program will contribute to West Virginia's economic development, advance its competitive edge globally and contribute to improvement in the quality of life.

The American Society of Mechanical Engineers (ASME) defines mechanical engineering as "the branch of engineering that serves society through the analysis, design, and manufacture of systems, at all size-scales that convert a source of energy to useful mechanical work." In 2004, the ASME noted in its publication, "A Vision of the Future of Mechanical Engineering Education," that mechanical engineering education was "changing" in order to address "societal concerns." As such, the BSME program at Marshall University (MU) will emphasize service, systems-based knowledge, and sustainability with an eye toward the interface of traditional mechanical engineering with new and emerging fields. In accordance with the standards set forth by the Accreditation Board for Engineering and Technology (ABET) and MU's mission, the specific educational objectives of this program are to graduate students who will:

1. Practice the mechanical engineering discipline successfully within community-accepted standards
2. Possess teamwork and communications skills to develop a successful career in mechanical engineering
3. Fulfill professional and ethical responsibilities in the practice of mechanical engineering, including social, environmental and economic considerations,
4. Engage in professional service, such as participation in professional society and community service
5. Engage in life-long learning activities, such as graduate studies or professional workshops, and
6. Develop a professional career in the prevailing market that meets personal goals, objectives and desires

Accordingly, graduates will have the ability to work professionally and ethically, as individuals and in multi-disciplinary teams, in both the thermal and mechanical systems areas, including the design, manufacture, and control of such systems. Moreover, they will develop a deep understanding of the impact of engineering solutions from a global, financial, environmental, societal, political, ethical, health and safety, and sustainability perspectives.

The University and the Weisberg Division of Engineering will actively recruit and train students from under-represented populations in the West Virginia and Tri-State region, beginning in middle school and continuing through high school. The BSME degree program will be built on the foundation of the faculty members and facilities in MU's ABET-accredited B.S. degree program in General Engineering (BSE). To a substantial extent, the supporting coursework and infrastructure for a new BSME program is in place as a result of our current program in general engineering, most of the cost of the expanded program will be incremental and offset by the current program. The proposed BSME program, however, is geared toward

1. Program Description

After a decade's-long absence, undergraduate engineering education was reestablished on the Marshall University campus in the fall of 2006 when the Marshall University Board of Governors approved the Bachelor of Science in General Engineering (BSE) degree. The BSE degree is a general engineering that also allows students to pursue areas of emphasis in particular engineering fields of study. Based on student interest and regional needs, the first area of emphasis offered was civil engineering (CEE). During this time, the BSE program has continued to grow and develop and provide additional resources to its students. The program moved into the newly constructed Arthur Weisberg Family Engineering Laboratory building in 2009, which houses most of the current engineering faculty and associated laboratories and student study resources. Since 2009, the program has grown and acquired many resources to add another area of emphasis. Based on market demands and the available resources, we believe it is the right time to expand engineering program to include a mechanical engineering discipline. For instance, the program has recently hired four new full time tenure track faculty in the area of mechanical engineering. Construction is also underway on the Arthur Weisberg Applied Engineering Complex, a 145,000 square ft. facility that will serve as the new home for all of the academic programs in the College of Information Technology and Engineering, including the BSE program, with associated expanded teaching and research laboratories, classrooms, offices, computer laboratories, and student study/work areas. The General Engineering Program (BSE) is a broad interdisciplinary program which, often, does not lend itself well to multiple areas of emphasis. Therefore, adding a mechanical engineering area of emphasis proved to be problematic and cumbersome at least in issues related to ABET accreditation. After careful and in-depth analysis, the faculty of the Weisberg Division of Engineering along with the Engineering Advisory Board believe creating a Bachelor of Science in Mechanical Engineering (BSME) is the appropriate approach to address current and future demands for engineers within the discipline.

1.1 Program Mission

The Objectives of the Bachelor of Science in Mechanical Engineering (BSME) program has several key components:

1. Practice the mechanical engineering discipline successfully within community accepted standards
2. Possess teamwork and communications skills to develop a successful career in mechanical engineering
3. Fulfill professional and ethical responsibilities in the practice of mechanical engineering, including social, environmental and economic considerations,
4. Engage in professional service, such as participation in professional society and community service
5. Engage in life-long learning activities, such as graduate studies or professional workshops
6. Develop a professional career in the prevailing market that meets personal goals, objectives and desires

1.2.1 Program Learning Outcomes

Mechanical Engineering is an engineering discipline that requires an understanding of mechanics, kinematics, thermodynamics and energy, and involves the application of principles of physics and mathematics to develop mechanical systems. The American Society of Mechanical Engineers (ASME) defines mechanical engineering as: the branch of engineering that serves society through the analysis, design, and manufacture of systems, at all size-scales that convert a source of energy to useful mechanical work. The discipline has evolved to include micro-, nano- and bio-systems, nano- and bio- materials, renewable, alternative fuels (Such as Coal-to-SNG), and energy systems.

BSME Program Learning Outcomes: Marshall University BSME graduates shall have:

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
l. an ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes.
m. an ability to work professionally in thermal systems
n. an ability to work professionally in mechanical systems

1.2.2 Additional Program Outcomes:

In addition to above listed Outcomes the BSME program will prepare students to become professional engineers after the required industrial experience. Mechanical Engineering students will be involved in research. The BSME program will allow science and biomedical students interested in high-tech devices to apply advanced manufacturing, control, and transport techniques to biotechnology and/or bioengineering problems. BSME students will be able to take science, biochemistry, and biomedical courses in addition to courses in subjects that are fundamental to ME. Moreover, the program will incorporate an optional five-year schedule involving a cooperative educational experience whereby the students in the latter part of their studies have periodic full-time work experiences in their area of interest with participating industries and businesses. Alternatively, a student may choose a fast-track approach and finish in

C. Curriculum

As the sample Curriculum Plan illustrates (Appendix A), the BSME program has been designed with these goals in mind by providing an approximately equal mix of foundational mathematics and science courses (25%), core engineering courses (28%), and mechanical engineering courses (25%). Technical elective courses provide students an opportunity to get additional specialization or pursue individual interests.

The following tables identify the required courses and prescribed electives of the program. The courses with an asterisk (*) will be added once the program is approved. The remaining non-core curriculum engineering courses already exist (indicated by ^); to adapt these courses to mechanical engineering courses requires only moderate adjustments of the content of the courses.

Table 2: Program Required Courses

Prefix & Number	Required Courses	SCH
ENGR 102^	Introduction To CAD	2
ENGR 103^	Freshman Seminar	1
ENGR 104^	Engineering Profession	1
ENGR 111^	Engineering Computations	3
ENGR 213	Statics	3
ENGR 214^	Dynamics	3
ENGR 215^	Engineering Materials	3
ENGR 216^	Mechanics of Materials	3
ENGR 217*	Cooperative Education- CO-OP	1
ENGR 219^	Thermodynamics	3
ENGR 221^	Engineering Economics	3
ENGR 240^	Manufacturing Processes	3
ENGR 245*	Introduction to Circuits and Controls	3
ENGR 318^	Fluid Mechanics	3
ENGR 319^	Fluid Mechanics Lab	1
ME 310*	Thermodynamics II	3
ME 320*	Fluid Power	3
ME 325*	Mechanical Engineering Lab. I	1
ME 330*	Manufacturing Methods in Design	3
ME 340*	Design of Machine Elements	3
ME 350*	Heat Transfer	3
ME 410*	Kinematics & Design of Machines	3
ME 420*	Mechanical Instrumentations and Control	3

The Engineering Advisory Board (EAB) will also facilitate the pursuit of less formal relationships earlier in the students' curriculum through field experiences, internships, and co-ops beginning in the sophomore year. Students will be encouraged to pursue optional co-op assignments during summer or full-semester terms. The EAB will assist with the identification of such co-op opportunities.

All field experiences will conclude with an exit interview of both the student participant and the student's immediate supervisor of the project.

At the freshman level, the applications for BSME and BSE are similar, and the students will work jointly on lab projects. Furthermore, students in both programs will be integrated in the senior design courses of ENGR 451 - Project Management, ENGR 452 Senior Engineering Seminar and ENGR 453 –Senior Project (Capstone). Course descriptions are included in Appendix D.

1.2.5 Program Delivery:

The proposed BSME program will utilize classical instructional delivery methodologies. It will use the same instructional methods that are common in engineering education and supported or recognized by the American Society of Engineering Education (ASEE).

2. Program Need and Justification

2.1 Existing Programs:

Currently, there are two West Virginia state supported institutions (WVU &WVUIT) that offer an ABET-accredited degree program in Mechanical Engineering or closely related fields. West Virginia lags behind surrounding states in the number of accredited mechanical engineering programs as illustrated in the table below. West Virginia could realistically justify adding at least one additional BSME program and related fields and still remain barely at the average of the neighboring states which have, on average, 1.41 programs per million residents. It is also noteworthy to mention that many BSME or closely related programs listed in the table below are larger than those in the State of West Virginia and can accommodate larger student populations. For Instance, Ohio has at least eight programs that are comparable in size of the BSME program at WVU or larger.

Table 4: Existing BSME Programs in Surrounding States

State	BSME Programs	Population	BSME Programs/Million
Kentucky	6	4.34 million	1.38
Ohio	15	11.25 million	1.33
Pennsylvania	19	12.70 million	1.50
Virginia	11	8.01 million	1.37
West Virginia	2	1.89 million	1.05

foreign engineers who are generally trained in a traditional way. The need for engineers who can innovate for the future can only be met when we graduate engineers who are educated under a new paradigm proposed in the National Academy of Engineering (NAE) report entitled "The Engineer of 2020." The proposed BSME program will ramp up engineering education in West Virginia for meeting its own needs, and build the nation's capacity and provide incentives for graduating U.S. engineers in this critical area.

Several studies at the national, state, and local levels have delineated the overall needs for additional engineers and scientific personnel. For example, the National Academy of Engineering, the National Academy of Sciences and the Institute of Medicine recently produced a report (2007): "Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future." This report summarizes the huge demand for engineers and science (STEM) graduates in U.S. industries and universities. The report indicates that to address the deficit in engineering and scientific knowledge, the nation must import foreign nationals to close the gap between supply and demand. As financial opportunities in foreign countries increasingly develop via globalization, the U.S. is going to find itself with a deficit of talent that will negatively impact its ability to maintain its world leadership in science and engineering. The Gathering Storm report defines a "compelling call to action" to draw more underrepresented U.S. citizens into engineering and science.

Thomas Friedman in his highly acclaimed book "The World is Flat" highlights staggering statistics showing how far the U.S. trails the world in meeting its science and technology needs. Societal need for graduates of science and engineering has been a concern of policy makers and educators for many years and now this concern is exacerbated with advances in China and India. Foreign graduates are being sought for high-paying, knowledge-based jobs or the work is being outsourced because of a lack of qualified U.S. educated engineers. In his more recent publication, "Hot, Flat and Crowded," Mr. Friedman takes a look at the rapid changing of the world through climate change, population growth and globalization. In this 2008 book, he urges the U.S. to become a world leader in developing 'green' technologies needed for the coming era he calls the "Energy-Climate Era." Without becoming a leader in these technologies, he fears that the U.S. will be shunted aside by other nations. The need to take actions for maintaining the technological leadership of the United States is progressively becoming more urgent. Developing cutting-edge technology by cultivating innovation is critically important in this competitive environment.

Engineering education is one of the most important aspects of this innovation cultivating process. Many states are now recognizing a shortage of engineers and are taking actions to address this urgent problem. These conclusions have been reached through a deliberate process of studying the current state of engineering education in the state and country, future trends and needs of society, the role of the U.S. in the knowledge-based society and global economy for high-impacting jobs and markets, the need of the state for economic development and the role of MU as a public supported university in economic development.

Advances in the technological sector have increased the opportunities for mechanical engineers as new manufacturing technologies, materials, and products are developed and brought to market. Employment of mechanical engineers in manufacturing will continue to increase as the

occupations; or leave engineering for other reasons. Therefore, in the next 20-25 years US academic institutions are expected to graduate, on average, about 125,000 engineers per year to keep up with demands. The American Society of Engineering Education (ASEE), in its annual report (Engineering by the Number-2011; www. asee.org/colleges) reported that in 2010-2011, all US Institutions graduated only 83, 001 engineers of which 6.7% were nonresident aliens.

Employment of engineers is expected to grow about as fast as the average for all occupations over the next decade, but growth will vary by specialty. Mechanical engineers are projected to have about 7 percent employment growth over the projected decade, slower than the average for all occupations. But, some new job opportunities will be created due to emerging technologies in biotechnology, materials science, and nanotechnology. Additional opportunities outside of mechanical engineering will exist because the skills acquired through earning a degree in mechanical engineering often can be applied in other engineering specialties.

Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to increase productivity and expand output of goods and services. New technologies continue to improve the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past. Unlike some other occupations, however, technological advances are not expected to substantially limit employment opportunities in engineering because engineers will continue to develop new products and processes that increase productivity.

In West Virginia, as reported by many industrial leaders, a substantial percentage of all engineering jobs in the state are filled by graduates of out-of-state or foreign institutions. There are more than thirty large businesses in the Tri-State region that employ mechanical engineers. In recent years, many of these companies have had difficulty hiring qualified engineers and also had difficulty retaining them longer than five years. Local leaders assert that a substantial problem for them is the absence of a BSME in this region of the State to support local industries. Sample letters of support are available in Appendix C.

2.4 Program Impact:

Clearly, the addition of the BSME will make MU a more effective public university. The BSME program will allow science and biomedical students interested in high-tech devices to apply advanced manufacturing, control, and transport techniques to biotechnology and/or bioengineering problems. BSEME students will be able to take science, biochemistry, and biomedical courses in addition to courses in subjects that are fundamental to ME. In addition to the BSE, the engineering students and faculty will be able to utilize many existing academic programs and resources such as: Mathematics, Physics, Chemistry, Geology, and others especially in areas related to energy, bio-systems, sustainability and manufacturing, and the interdisciplinary research of these areas will be more readily transformed for use in the development of the state.

provide Co-Op and employment opportunities for the program's future students and graduates (Letters of Support are included in Appendix C).

2.6 Alternatives to Program Development:

There are two West Virginia state supported institutions (WVU &WVUIT) that offer an ABET-accredited degree program in Mechanical Engineering or closely related fields. West Virginia lags behind surrounding states in the number of accredited mechanical engineering programs. During the past few years, engineering faculty attempted to add a mechanical engineering area of emphasis to the General Engineering Program (BSE). But, the General Engineering Program (BSE) is a broad interdisciplinary program which, often, does not lend itself well to multiple areas of emphasis. Therefore, adding a mechanical engineering area of emphasis proved to be problematic and cumbersome at least in issues related to ABET accreditation. After careful and in-depth analysis, the faculty of the Weisberg Division of Engineering along with the Engineering Advisory Board believe creating a Bachelor of Science in Mechanical Engineering (BSME) is the appropriate approach to address current and future demands for engineers within the discipline.

3. Program Implementation and Projected Resource Requirement

1. Program Administration

The BSME program will be housed in the Weisberg Division of Engineering- College of Information Technology and Engineering. The Chairman of the Weisberg Division of Engineering will supervise and manage the program. No changes in the administration of the Division is projected.

2. Program Projections

The estimates for student enrollment are conservative and based upon the number of student inquiries and interest shown in the proposed degree. The estimates also assume that all students will be full-time and incorporates a dropout rate of approximately 20-25%. The 20-25% average drop rate is based on MU's experience with the BSE program and on data from similar institutions (WVU, WVIT, Ohio University and UK) with BSME programs. Some of the current BSE students will undoubtedly transfer to mechanical engineering and these will tend to stay since they have achieved a level of success in BSE and will be better prepared for the BSME than students who are new to the program. It is conceivable that once the BSME program is approved and ABET accredited, the newly founded INTO program on the MU may recruit foreign students interested in the BSME degree, but these figures are not included in the table below.

This new degree is projected to have around 200 majors in its fifth year. MU has a very strong commitment to recruiting students from underrepresented groups. The engineering program will actively recruit students from the underrepresented groups and International students to advance this mission.

Mechanical Engineering Program will be organized to educate engineers for careers devoted to the integration of discoveries from multiple fields and take advantage of multiple disciplines available in the University's liberal arts environment. MU already has all necessary academic units and complementary programs in general engineering to support this proposed Program. Weisberg Engineering faculty and academic resources will support needs for the new Program; however, three new faculty, five mechanical engineering related labs, about twenty new courses in the targeted Mechanical Engineering areas and one support staff will be needed.

As it was mentioned earlier Mechanical Engineering is wide engineering discipline that requires faculty with different expertise and knowledge. Therefore, a strong BSME program should have the support of faculty with following areas of expertise: Controls (or closely related), Design, Energy, Fluids, Kinematics and Mechanics (Dynamical Systems), Thermal Sciences and Thermodynamics, Manufacturing, and Materials. At the current time the Weisberg Division of Engineering has four engineering faculty with mechanical engineering background. Three more faculty will be needed to cover the following areas: Design, Controls, and Fluids and thermal Sciences. In addition the BSME program will require a technician or a skilled machinist to manage the machine shop and to provide support for faculty and students.

The listed tables to provide information about Core and Support faculty. An asterisk (*) indicates the individual who will have direct administrative responsibilities for the program. Appendix E contains a schedule of courses to be offered by semester, during the initial years of the program.

Table 6: Mechanical Engineering Faculty

Name of Core Faculty and Faculty Rank	Highest Degree	Courses Assigned in Program
Salem, Asad * Professor [Primary responsibility for administering the program]	PhD in Mechanical Engineering (Energy & Thermal Science)	ENGR 219, ME 310, 325,425, 430& 440
Chen, Gang Associate Professor	PhD in Mechanical Engineering (Dynamical Systems)	ENGR 213, 214, 216,ME,340,410 425, 435 & 460
Hijazi, Iyad Assistant Professor	PhD in Mechanical Engineering (Materials)	ENGR 102, 104, 111, 215, 217,453, ME 325 & 455
Sadique, Serdar Assistant Professor	PhD in Mechanical Engineering (Manufacturing)	ENGR 102, 213, 214,240, 453, ME 330, 425& 450
New Faculty (I) in Year 2016	PhD in Mechanical Engineering (Design)	ENGR 214, 216, ME 340, 410, 425&435
New Faculty (II) in Year 2016	PhD in Mechanical Engineering (Thermo-Fluids)	ENGR 219, 318, 319, 453,ME 325 & 350

Faculty Course Load Mapping

The following table shows a typical faculty course load when the program is fully staffed and implanted.

Table 8: The BSME Projected Faculty Course Load in 2016-2017

	Fall 2016					**Spring 2017**				
Faculty	ENGR	BSE	BSME	Total SCH	Total Cont. Hrs	ENGR	BSE	BSME	Total SCH	Total Cont. Hrs
Chen	**3**	**0**	**3**	**6**	**6**	**0**	**0**	**5**	**5**	**7**
Hijazi	**3**	**0**	**3**	**6**	**7**	**4**	**0**	**3**	**7**	**9**
Sadique	**6**	**0**	**3**	**9**	**9**	**0**	**0**	**6**	**6**	**8**
Salem	**1**	**0**	**3**	**4**	**4**	**0**	**0**	**3**	**3**	**3**
Bayisa	0	0	0	0	0	0	0	3	3	4
Mechatronics	7	0	0	7	8	0	3	3	9	10
Begley	3	3	0	3	6	3	3	1	10	10
Huffman	1	7	0	8	10	4	3	3	10	10
Michaelson	0	6	0	6	6	3	3	0	6	6
Wait	5	3	0	8	10	0	6	0	9	9
TOTAL (BSME)	**13**		**12**	**25**	**28**	**4**		**17**	**21**	**27**

From the above listed table, it is noticed that during a typical academic year the average teaching load for a designated BSME faculty is 11.5 SCH of undergraduate related courses/ year (14 contact Hours). Therefore, the faculty will have 25-30% time release to pursue their research interests.

4. Library Resources and Instructional Materials

MU libraries have many of the resources necessary to support a new program in Mechanical Engineering. Monographic, journal and database holdings enable the libraries to provide initial support for the program. Most of the resources available are not discipline specific but are available through multidisciplinary databases and may provide the depth of breadth of material required to support such a degree. Keeping in mind, MU libraries are currently supporting the BSE and the MSE programs. However, some improvements in the collections will be required to ensure that they can adequately support the Mechanical Engineering program consistently over the long-term.

The Mechanical Engineering program will require at least one additional full-text database, ASME, to support its program. This resource will cost approximately $12,000 for the first year, with estimated increase in costs of 10-20% per year annually (based on increases for comparable databases). Additional costs will be incurred for the purchase of electronic full-test reference resources, standards, technical manuals and guides, and monographs to support the program. Additional funding needed in the first year will be approximately $30,000 for these resources. Maintenance costs for these resources will be recurring annually and will be established at the time of contract negotiation and signing. However, it is projected that the required additional

Heat Transfer Laboratory			x	x	$75,000
Industrial Controls & Instrumentation Systems Laboratory	x	x			$105,000
Robotics & Mechanical Systems Laboratory	x	x			$95,000
CAD & Computing Laboratory	x				$50,000
Total	$450,000	$100,000	$100,000	$100,000	$750,000

The total projected, therefore, for the teaching labs for the basic mechanical engineering courses is $550,000. The prescribed technical elective courses with the emphasis in nano- and energy sciences will require additional equipment totaling approximately $200,000. Budget projections include $10,000/year for normal supplies and materials for the first three years and $6000/year thereafter. It is noteworthy to mention that the industry has pledged to provide around $450,000 to support the mechanical engineering program lab needs. Therefore, the actual requirements is about $300,000.

6. Facilities Requirements

Adequate resources exist for laboratory and support services. No new needs are anticipated. Space for classrooms is adequate. The proposed program will not require the addition of new space or facilities or the remodeling or renovation of existing space.

7. Operating Resource Requirements

Normal operating expenses will be necessary for his program. Office space for three additional faculty is available. Additional office supplies would be required, along with voice and data services and devices. Other requirements may include nonrecurring expenses such as program start-up/development expenses are presented in FORM 2 and in the attached spreadsheet (Appendix G). The operational budge will come from student tuitions and fees.

8. Source of Operating Resources

All operational support will come from student tuitions and program specific fees.

As it was mentioned earlier, at the current time the Weisberg Division of Engineering has four engineering faculty with mechanical engineering background, and has five additional faculty who will teach existing engineering courses that required by the BSME and by the existing BSE. FORM 2 and a spread-sheet (Appendix G) show the operating resources requirements as well as the sources of operating resources, including personnel expenses, and nonrecurring expenses (such as program start-up/ development expenses), annual operating expenses. It also, shows the total and net annual revenues and the cumulative return.

Appendix A

Bachelor of Science –Mechanical Engineering (BSME)

Pattern Sheet

Semester 1	SCH	Status	Semester 2	SCH	Status
MTH 229 Calculus I	5	Existing	MTH 230 Calculus II	4	Existing
ENG 101 English	3	Existing	Core II Social Science	3	Existing
FYS 100 First Year Seminar	3	Existing	PHY 211 Physics I	4	Existing
Core I Communications	3	Existing	PHY 202 Physics I Lab	1	Existing
ENGR 103 Freshman Seminar	1	Modified	ENGR 102 Intro to CAD	2	Modified
ENGR 104 Engineer. Profession	1	Modified	CHM 211 Chemistry I	3	Existing
	16			**17**	
Semester 3			**Semester 4**		
MTH 231 Calculus III	4	Revised	ENGR 240 Manuf. Proc.	3	New
ENGR 111 Engineering Comp.	3	Modified	ENGR 245 Intro. Circuits and Cont.	3	New
ENGR 213 Statics	3	Existing	ENGR 219 Thermodynamics	3	Revised
ENGR 215 Engr. Materials	3	New	ENGR 214 Dynamics	3	Revised
PHY 213 Physics II	4	Existing	ENGR 216 Mech. of Mater.	3	Modified
PHY 204 Physics lab II	1	Existing	ENGR 217 Co-Op	1	New
	18			**16**	
Semester 5			**Semester 6**		
MTH 335 Differential Equations	4	Existing	ENG 201 Adv. Communication	3	Existing
ENGR 318 Fluid Mechanics	3	Modified	MTH 345 Applied Stats	3	Existing
ENGR 319 Fluid Mechanics Lab	1	Modified	ENGR 221 Engr. Econ	3	Existing

Appendix B

Weisberg Division of Engineering
Bachelor of Science –Mechanical Engineering (BSME)

Cooperative Education Program
Student Schedule Layout
OPTION I

	Fall	Spring	Summer
Freshman Year	Classes	Classes	
Sophomore Year	Classes	Classes	
Junior Year	Classes Apply to CO-OP	CO-OP	CO-OP
Senior Year 1	Classes	Classes	CO-OP
Senior Year 2	CO-OP	Classes	

FRESHMAN YEAR & SOPHOMORE YEAR

Students spend their freshman and sophomore years in classes trying to earn the highest GPA as possible. In the summer between freshman and sophomore and the summer between sophomore and junior year, students are encouraged to pursue internships, participate in research, or take summer courses to get ahead or improve GPAs. These years should be dedicated to building strong resumes for the Co-Op program.

JUNIOR YEAR

FALL: Students apply to the CO-OP program, attend an orientation meeting, attend all professional preparation meetings, and interview with companies looking for students.

SPRING and SUMMER: Students gain full-time engineering experience at a company while receiving pay.

SENIOR YEAR 1

FALL: Students continue their education and complete more classes.

SPRING: Students continue to take classes, but again go through the interview process for a second CO-OP position. This position could be with the same company the student first CO-OPed with, but does not need to be. Many students prefer to explore multiple kinds of companies.

SENIOR YEAR 2

FALL: Students continue their second CO-OP experience.

SPRING: Students complete their final semester of classes in order to graduate. CO-OP students report ease in finding full-time positions in a competitive market due to their professional experience.

Appendix C

Letters of Support

Marathon Petroleum Company LP

11631 US 23
Catlettsburg, KY 41129
Telephone 606/921-3333
FAX 606/921-3290

September 22, 2014

Asad A. Salem, Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
Marshall University
Huntington, WV 25755-2586

Re: Marathon's Support of Marshall University developing a Mechanical Engineering Program

Dear Dr. Salem:

On behalf of Marathon Petroleum Corporation, I would like to express support for the development and accreditation of a Mechanical Engineering program at Marshall University. Marathon maintains a strong presence in the tri-state area in the form of our Catlettsburg (KY) Refinery, and other local facilities. 81 Marshall graduates are currently employed at the Catlettsburg site, but only two of those are recent engineering graduates. Having a vibrant Mechanical Engineering presence locally would provide an excellent source of engineers for Marathon and a source of jobs for Marshall graduates. Marathon employs a large number of engineers throughout our seven-refinery system and support groups. The Catlettsburg Refinery currently employs 113 degreed chemical, mechanical, electrical, and civil engineers. We utilize Mechanical Engineers in a variety of roles including project engineering, project management, maintenance support, and equipment reliability in addition to supervisory positions. We also utilize a robust co-op student program that involves the employment of engineering students to fill over 80 year-round positions. Marathon would welcome a quality, local source of engineers to fill these full-time and co-op positions.

Currently we recruit at a number of universities within reasonable proximity to our refineries including several that surround Marshall University (Virginia Tech, West Virginia Tech, The Ohio State University, University of Toledo, University of Cincinnati, University of Louisville, and The University of Kentucky). Marshall University would make a nice fit into our recruiting network and Marathon would provide an attractive source of employment opportunities for Marshall University ME graduates.

In summary, Marathon wholeheartedly supports the continued development of Marshall's Engineering Department in general and the Mechanical Engineering Department in particular. A recent forecast by Kelly Services quoted in Civil Engineering magazine (September 2014) predicts an increase of almost 250,000 engineering jobs in the US economy in the next ten years of which over 25,000 of those will be mechanical engineers. With the continued growth in the oil and gas sector including the Utica and Marcellus shale areas in West Virginia, Ohio, Pennsylvania, and New York, many of those jobs will be very reachable for Marshall graduates. Now is an excellent time to begin meeting the needs of the engineering market.

Sincerely,

Dan Schlaeppi
Engineering Manager
Catlettsburg Refining, LLC

CC: J. Lane
R. Hernandez
G. Jackson
M. Churton

January 2, 2015

Asad A. Salem, Ph.D
Professor and Chair
Weisberg Division of Engineering
College of Information Technology and Engineering
One John Marshall Drive
Huntington, WV 25755-2586

Dear Dr. Salem:

I wanted to take a moment and to tell you that I am pleased that Marshall University is expanding their engineering program to include a Bachelor and Masters of Science in Mechanical Engineering. As you are aware I have been associated with the engineering program at Marshall during my forty year career at the U.S. Corps of Engineers in Huntington, West Virginia and now during my career at Triad Engineering, Inc. Although my professional work is more directly related to the civil engineering profession, I often work on projects that require the services of a mechanical engineer. From my experience at the Corps and working with other firms that provide mechanical engineering services, the addition of the Mechanical Engineering program at Marshall University will help to fulfil a shortage of mechanical engineers in this area.

I fully support the addition of a Bachelor and Masters of Science in Mechanical Engineering at Marshall University.

Sincerely;

David F. Meadows, P.E., P.S.
Southwest Regional Manager

10541 Teays Valley Road | Scott Depot, WV 25560
304.755.0721 304.755.1880 www.triadeng.com

Appendix D

Course Descriptions

ENGR 217 Engineering Co-op Preparation
This course will prepare students for both the job search and employment in the field of engineering. Students will learn strategies for conducting a successful job search, including the preparation of resumes and cover letters, behavioral interviewing techniques, and effective use of social media in the application process. Professional and ethical responsibilities during the job search and for co-op and subsequent professional experiences will be discussed. (At least second-year standing) CR (1,0,1)

ENGR 245 Introduction to Circuits and Controls
Basic DC and AC Circuit Analysis including circuit variables and measurement, basic DC and AC circuit laws and analysis, Three phase circuits and basics control theory and applications of computer and PLC based controls. (At least second-year standing) CR (3,0,3)

ME 310 Thermodynamics II
Advanced design and analysis of gas and vapor power cycles, including cogeneration and combined cycles, using concepts of energy based on the 2nd Law of Thermodynamics and the field of thermo-economics. Emphasis is also placed on determining entropy generation and irreversibility within fuel cells and fossil fuel combustion processes using chemical energy as well as developing equations of state. (Pre-requisite: ENGR 219) **CR (3,0,3)**

ME 320 Fluid Power
This course is designed to provide a solid foundation for understanding hydraulic and pneumatic systems for power transmission and motion control. Applications include mobile and stationary equipment. This course covers key operating characteristics of most fluid power system components including compressors, pumps, valves, cylinders, and motors, design fluid power circuits, mathematically model the steady state operation of fluid power systems. The course includes a hands-on laboratory offering the chance for students to construct circuits, see component cutaways, experience component and system performance demonstrations, and work with electronic control of hydraulic systems. (Pre-requisite ENGR 319) CR (2,1,3)

ME 325 Mechanical Engineering Lab (I)
Experimentation and analysis of thermal/fluid systems, energy balances, performance measurements of devices and systems, data analysis and correlation, elements of experimental design. (Co-requisite: ME 350) CR (0,1,1)

ME 330 Manufacturing Methods in Design

Overview of manufacturing processes with emphasis on the fabrication of materials from the processing and equipment viewpoint. This course presents a broad study of the many manufacturing processes utilized in the production of a wide variety of products and components. Insight into the multitude of processing factors which influence the practical design of manufactured parts to achieve the advantages of maximum economy, accuracy and automation in everyday production. (Pre-Requisite: ENGR 240) CR (3,0,3)

ME 340 Design of Machine Elements

ME440 Design of Energy Systems

Installation, design characteristics, operational performance, and maintenance of motors, turbines, pumps and compressors. Introduction to global energy concerns; fossil and nuclear fuels; energy consumption analysis; energy management and conservation techniques. (Pre-requisite ME 350) CR (3,0,3)

ME 445 Hydraulic and Pneumatics Controls

This course covers theory, fundamentals, and application of hydraulic and pneumatic systems. Emphasis is placed on practical application of fundamental fluid power principles. Students will learn through hands-on lab experience, fluid power circuits, terminology, symbols, and calculations for force, velocity, and horsepower. In addition students will apply circuit fundamentals in the design of manufacturing, construction, or transportation models using software tools. Introductory control of pneumatics using PLC's (Programmable Logic Controller's) is a special feature of this course. The ability to communicate clearly in writing and possession of math skills will be considered important in this class. (Pre-requisite ME 320) CR (3,0,3)

ME 447 Engineering Analysis

Analytic models for engineering processes and systems in fluid mechanics, heat transfer, rigid body dynamics, and machine design. Practical interpretations of analytic and approximate solutions for steady and non-steady state problems. Introduction to linear algebra and statistics and their applications in engineering analyses

ME 450 CNC and Rapid Prototyping

This course teaches students the fundamentals of computer aided manufacturing (CAM), computer numerical control (CNC) machining, and rapid prototyping (RP). Students will learn how to program a CNC machine using manual G/M code programming and computer aided manufacturing software. The course also provides an overview of rapid prototyping (freeform fabrication) technologies, and students will compare part production via RP and CNC. (Pre-requisite ENGR 240) CR (3,0,3)

ME 455 Metallurgy

This course is to provide a physical basis that links the structure of materials with their properties, focusing primarily on metals. With this understanding in hand, the concepts of alloy design and microstructural engineering are also discussed, linking processing and thermodynamics to the structure and properties of metals. (Pre-requisite ENGR 215) CR (3,0,3)

ME 460 Vibrations

The theory of mechanical vibrations with an emphasis on design applications and instrumentation. Fourier analysis techniques, numerical and experimental analysis and design methods are presented in addition to theoretical concepts. Vibrations of single-degree of freedom systems are covered, including free-damped and un-damped motion; and harmonic and transient-forced motion, such as support motion, machinery unbalance and isolation. Modal analysis of multi-degree of freedom systems is introduced. In addition to laboratory exercises on vibration instrumentation, an independent design project is assigned. CR(3,0,3)

Appendix E

Course Offerings by Semester

	Fall	Faculty	SCH	Spring	Faculty	SCH
I	ENGR 103	Wait	1	ENGR 102	Hijazi	2
2015-16	ENGR 103	Salem	1	ENGR 102	Hijazi	2
	ENGR 104	Hijazi	1	ENGR 102	Huffman	2
	ENGR 104	Hijazi	1	ENGR 102	Huffman	2
	ENGR 104	Hijazi	1	ENGR 240	Sadique	3
	ENGR 213	***Mechatronics***	3	ENGR 240	Sadique	3
	ENGR 213	Michaelson	3	ENGR 245	Bayisa	3
	ENGR 214	Sadique	3	ENGR 217	Chen	1
	ENGR 214	Sadique	3	ENGR 216	Michaelson	3
	ENGR 215	Hijazi	3	ENGR 219	Salem	3
	ENGR 216	Chen	3	ENGR 221	Begley	3
	ENGR 318	Wait	3	ENGR 221	Wait	3
	ENGR 319	Wait	1	ME 320	***Mechatronics***	3
	ME 310	Salem	3	ME 325	Chen	1
	ME 330	Sadique	3	ME 350	Salem	3
	ME 340	Chen	3	Tech. Elective (I)	Hijazi	3
	Total Cr. Hours (36)			Tech. Elective (II)	Chen	3
				Total Cr. Hours (43)		
II	ENGR 103	Wait	1	ENGR 102	Hijazi	2
2016-17	ENGR 103	Hijazi	1	ENGR 102	Hijazi	2
	ENGR 104	Wait	1	ENGR 102	Huffman	2
	ENGR 104	Hijazi	1	ENGR 102	Huffman	2
	ENGR 104	Hijazi	1	ENGR 240	Sadique	3
	ENGR 104	Chen	1	ENGR 240	Sadique	3
	ENGR 213	Sadique	3	ENGR 245	ME-III	3
	ENGR 214	Chen	3	ENGR 217	Begley	1
	ENGR 214	Sadique	3	ENGR 216	Michaelson	3
	ENGR 215	Hijazi	3	ENGR 219	ME-II	3
	ENGR 216	Chen	3	ENGR 221	Begley	3
	ENGR 318	Wait	3	ENGR 221	Wait	3
	ENGR 319	Wait	1	ME 320	ME-III	3
	ENGR 319	Salem	1	ME 325	ME-II	1
	ME 310	ME-II	3	ME 350	ME-II	3
	ME 330	Sadique	3	ENGR 453	Chen	3
	ME 340	ME-I	3	ME 440	Salem	3
	ME 410	ME-I	3	Design Elective	ME-I	3
	ENGR 451	Begley	3	Tech. Elective (I)	Hijazi	3
	ME 420	ME-III	3	Tech. Elective (II)	Chen	3
	ME 425	ME-I	1	Tech. Elective (III)	ME-I	3
	ENGR 452	Huffman	1	**Total Cr. Hours (55)**		

Appendix F: ABET Standards

GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS

All programs seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy all of the following General Criteria for Baccalaureate Level Programs

General Criterion 2. Program Educational Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria

General Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for

APPENDIX G

Attached Spread Sheet
FIVE-YEAR COST and FUNDING

BSME PROGRAM BUDGET PRO FORMA

	Base Salary (Year 1)	Benefits	Year of Hire	Year of Prom	FISCAL YEAR EXPENSES Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
		27%								
	Annual Salary Increase:		3%							
Adim:Faculty Position 0 - Chair-1/2 time Existing	$ 60,000	$16,200	-	99	$ 73,981	$ 76,200	$ 78,486	$ 80,841	$ 83,266	$ 85,764
Faculty Position 1- Asst. Professor (0.5FTE)	$ 57,500	$15,525	2	99	$ -	$ -	$ 75,216	$ 77,472	$ 79,796	$ 82,190
Faculty Position 2 -Asst. Professor (0.75 FTE)	$ 86,250	$23,288	2	99	$ -	$ -	$ 112,824	$ 116,208	$ 119,695	$ 123,285
Faculty Position 3 -Asst. Prof(0.75 FTE)	$ 86,250	$23,288	2	7	$ -	$ -	$ 112,824	$ 116,208	$ 119,695	$ 123,285
Faculty Position 1- Asst. Prof Existing (0.75 FTE)	$ 56,250	$15,188	-	8	$ 69,357	$ 71,438	$ 73,581	$ 75,788	$ 78,062	$ 80,404
Faculty Position2 - Asst.Prof Existing (0.75 FTE)	$ 58,125	$15,694	-	8	$ 71,669	$ 73,819	$ 76,033	$ 78,314	$ 80,664	$ 83,084
Faculty Position 3 - Assoc. Prof Exist (0.75 FTE)	$ 64,125	$17,314	-	7	$ 79,067	$ 81,439	$ 83,882	$ 86,398	$ 88,990	$ 91,660
Equivalent Faculty Position - (BSE)(0.75 FTE)	$ 65,250	$17,618	-	7	$ 80,454	$ 82,868	$ 85,354	$ 87,914	$ 90,552	$ 93,268
Faculty Position 0 - Asst Prof	$ -	$ -	2	8	$ -	$ -	$ -	$ -	$ -	$ -
Faculty Position 0- Asst Prof	$ -	$ -	3	9	$ -	$ -	$ -	$ -	$ -	$ -
Classified Employee 1 (1/2 time)	$ 37,500	$10,125	-		$ 50,862	$ 52,388	$ 53,959	$ 55,578	$ 57,245	$ 58,963
Classified Employee0 (1/2 time)	$ 12,500	$ 3,375	1		$ -	$ 17,463	$ 17,986	$ 18,526	$ 19,082	$ 19,654
Classified Employee 0	$ -	$ -	1		$ -	$ -	$ -	$ -	$ -	$ -
PERSONNEL TOTAL					**$ 425,388**	**$ 455,613**	**$ 770,144**	**$ 793,248**	**$ 817,046**	**$ 841,557**
Section Notes: Update positions, salaries, year of hire and year of promotion. Annual costs will automatically calculate. Set salary of position to zero if not needed.										
Nonrecurring Expenses (PROGRAM START-UP/DEVELOPMENT)						$ 379,413	$ 390,795	$ 402,519	$ 414,594	$ 427,032
New Program Application					$ -	$ -				
Annual Accreditation Fees						$ -	$ -	$ 1,500	$ 1,575	$ 1,654
Accreditation Comprehensive Visit						$ -		$ 12,000		
Annual Sustaining Fees						$ -	$ -	$ 1,500	$ 1,575	$ 1,654
New Program Consultation Expenses					$ -	$ -	$ -			
Travel and Profession Conferences					$ 10,000	$ 16,000	$ 23,000	$ 23,690	$ 24,401	$ 25,150
Staff Development					$ 460	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Recruiting Expenses					$ 35,000	$ 30,000	$ 25,000	$ 25,000	$ 20,000	$ 20,000
Professional Fees						$ 10,000	$ 10,600	$ 11,236	$ 11,910	$ 12,625
Faculty Start-Up Allowances/Relocation						$ 30,000	$ 75,000	$ 75,000	$ -	$ -
Nonrecurring Expenses (PROGRAM START-UP/DEVELOPMENT)					**$ 45,460**	**$ 87,000**	**$ 134,600**	**$ 150,926**	**$ 60,461**	**$ 62,083**
Section Notes: Itemized lines are examples. Update lines and annual amounts as necessary.										

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Program Fee -Res		800	800	800	800	800
Program Fee - Nonres		800	800	800	800	800
Fee Incr Res (E&G)			5.00%	5.00%	5.00%	5.00%
Fee Incr Nonres (E&G)			5.00%	5.00%	5.00%	5.00%
E&G Res	1st year	$ 5,535	$ 5,811	$ 6,102	$ 6,407	$ 6,727
E&G Nonres	1st year	$ 13,770	$ 14,459	$ 15,182	$ 15,941	$ 16,738
Total Res Students	1st year	79	115	135	152	155
Total Nonres Students	1st year	29	46	55	65	68
Total Res Students	2nd year		59	86	101	114
Total Nonres Students	2nd year		19	30	36	42
Total Res Students	3rd year		-	47	69	81
Total Nonres Students	3rd year		-	15	24	29
Total Res Students	4th year		-	-	43	62
Total Nonres Students	4th year		-	-	14	22
Retention - Resident Yr 1 to Yr 2			75%	75%	75%	75%
Retention - Nonresident Yr 1 to Yr 2			65%	65%	65%	65%
Retention - Resident Yr 2 to Yr 3			80%	80%	80%	80%
Retention - Nonresident Yr 2 to Yr 3			80%	80%	80%	80%
Retention - Resident Yr 3 to Yr 4			90%	90%	90%	90%
Retention - Nonresident Yr 3 to Yr 4			90%	90%	90%	90%