September 29, 2016

Dr. Paul Hill, Chancellor  
West Virginia Higher Education Policy Commission  
1018 Kanawha Boulevard, East, Suite 700  
Charleston, WV  25301

Re: Shepherd University, Series 11, Intent to Plan for the  
Bachelor of Science in Engineering Science (B.S., ES)

Dear Chancellor Hill:

Enclosed please find the Series 11 (Section 5) Intent to Plan for Shepherd’s proposed degree program, the Bachelor of Science, Engineering Science. The institutional Board of Governors approved the intent to plan document at its September 27th meeting. Please see the enclosed pages from the board agenda book, which may also be found here: http://www.shepherd.edu/wordpress-1/wp-content/uploads/2016/09/0-Sept16-BoG-pkt-Electronic-v9-23-16.pdf

This interdisciplinary major is designed to provide students with exposure to subjects that form the rudiments of engineering and the applied sciences. An integral part of the program also includes core topics in engineering and physics. The proposed program also encompasses computer engineering and computer sciences topics, providing students with the necessary knowledge and skills in embedded and control systems. These skills are highly desired and utilized in the field of robotics, both in hardware and software. The environmental engineering concentration would be the only degree of its kind in the state solely focused on applying engineering technology to environmental issues, its problems, and its solutions.

Employment trajectories for graduates in this field are strong. As West Virginia strives to diversify its economy, the need for qualified employees in these disciplines represents a potential area of employment growth for the state. The U.S. Department of Labor notes in its demographic data that West Virginia ranks below the median rate in the number of engineers for the location.

Any questions regarding the proposed intent to plan documents may be directed to Dr. Christopher Ames, Provost, at cames@shepherd.edu or 304-876-5176. Upon approval, we plan to submit the Section 6 implementation plan as soon as possible, with the hopes of implementing the program in August 2017. Your attention to this proposal is greatly appreciated.

Sincerely,

Mary J.C. Hendrix
President

cc: Dr. Corley Dennison, Vice Chancellor for Academic Affairs

Excellence Innovation Opportunity: Training the Next Generation of Leaders and Model Citizens
SHEPHERD UNIVERSITY
BOARD OF GOVERNORS MEETING
4:15 p.m.
September 27, 2016
Shepherdstown, WV

AGENDA

Regular Session
Lower Level Multipurpose Room
Robert C. Byrd Center for Congressional History and Education

1. Call to Order
2. Public Comments
3. Oath of Office – New Members
4. Adoption of the Minutes from June 2, 2016 Board Meeting
5. Adoption of the Minutes from August 25, 2016 Special Board Meeting
6. President’s Report
8. Tuition and Fee Waiver Report: FY2016
9. Approval of Medical Facility Project

10. Additional Authorization for Refinancing of Bonds

12. Intent to Plan for Bachelor of Science, Engineering Science
13. Adjustment of Administrative Organization – University Communications
14. Naming of the New West Campus Residence Hall Facility
15. Metro Scholarship Rate Presentation

16. New Business

Adjournment
INTENT TO PLAN FOR
BACHELOR OF SCIENCE, ENGINEERING SCIENCE

Board of Governors approval is sought to develop a new Bachelor of Science in Engineering Science program. If approved by the Board, the University would submit an Intent to Plan to the Chancellor for approval. The draft Intent to Plan for the Policy Commission is included for a complete description of the rationale for the program. After approval of the Intent to Plan by the Chancellor, the University expects to complete the final program proposal quickly with the hope of implementing the new degree program in Fall 2017.

The following resolution is recommended for adoption by the Board:

RESOLVED, That the Shepherd University Board of Governors approves the development of a Bachelor of Science in Engineering Science and authorizes the President to file an Intent to Plan with the Chancellor of the Higher Education Policy Commission for approval.

Note: The resolution was passed unanimously by the BoG on 09/27/16
Shepherd University

WV-HEPC Series 11 Intent to Plan

Date: August 2015
Category of Action: Implementation Plan (Section 5 of Series 11)
Title of Degree: Bachelor of Science, Engineering Science (B.S., ES)
Location: Shepherd University

Effective Date
of proposed action: Fall 2017

Submission of Full proposal
(Implementation Plan): January 2017

Shepherd University

Dr. Mary J. C. Hendrix, President
Dr. Christopher Ames, Provost
Dr. Colleen Nolan, Dean, School of Natural Sciences and Mathematics
Reza Mirdamadi, Chair, Department of Computer Science, Mathematics and Engineering
Dr. Scott Beard, Associate Provost
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5.2. A request to develop a plan should indicate the projected date of submission of the full proposal and the projected date of implementation.

This submission of the Intent to Plan (WV-HEPC Series 11) is a comprehensive proposal for the Bachelor of Science, Engineering Science degree at Shepherd University. The proposal was approved by the Shepherd University Board of Governors on September 27, 2016 and following approval of the intent to plan from the West Virginia Higher Education Policy Commission (HEPC), the University will submit a full proposal (section 6 of Series 11-Implementation Plan) and would be poised to begin offering this multi-disciplinary major in fall 2017.

5.2.a. Educational Objectives

The proposed Engineering Science major is a 120-credit hour program designed to provide students with exposure to subjects that form the rudiments of engineering and the applied sciences. This interdisciplinary degree program includes subject areas in applied mathematics (i.e., differential equations), linear algebra, operations research and numerical analysis. An integral part of the program also includes core topics in engineering and physics: digital and analog electronics, thermodynamics, linear systems, electromagnetic fields, statics and dynamics, all of which are built on advanced mathematical concepts. The proposed program also encompasses computer engineering and computer sciences topics to provide students with the necessary knowledge and skills in embedded and control systems. These skills are highly desired and utilized in the field of robotics, both in hardware and software. Basic topics in management such as Economics and Principles of Management and courses in Computer Networking are also included to provide a well-rounded experience for students.

High-impact practices identified by AAC&U (American Association of Colleges and Universities) on teaching and learning are expected to play a prominent role in this program, specifically, entry-level and capstone courses, experiential learning, undergraduate research, and collaborative assignments. As with all courses at Shepherd, syllabi identify core competencies such as critical thinking, scientific inquiry, oral and written communication, life-long and integrative learning.

These best practices include and will be augmented by the following means:

- Lab experiences to expose students to connections between abstract concepts and real-world applications through design oriented projects;
• Opportunity to specialize in a particular area in engineering and applied sciences in the Senior Capstone class, where faculty members will guide students on projects that could result in presentations/publications at professional conferences.
• Emphasis on undergraduate research and believes Engineering Science will serve as an excellent avenue for this high-impact practice.

The proposed Engineering Science Degree program will have two concentrations.

Environmental Engineering
The environmental engineering concentration prepares students for careers in applying engineering technology to environmental issues and problems. The need for trained environmental engineers is illustrated through the numerous employment opportunities available for individuals trained in this field, in industry or at state and federal agencies, and with environmental consulting firms. According to https://collegegrad.com/, prospects for employment should be favorable due to anticipated population growth, as well as a wave of retirements in that field. Furthermore, job growth in this area is expected to increase 12% over the next decade. There has been a great emphasis in recent years by state and local governments regarding environmental assessment, planning and design–in particular, concerns about water safety. This has led to efforts to increase the efficiency of water use and monitoring its quality, demonstrating an example of the need for environmental engineers. Current and future employment growth is projected to be in professional, scientific, and technical services, as municipalities draw on the expertise of environmental engineers to address these issues.

The program curriculum provides students with skills to achieve success in this challenging field, along with further field experience through a required internship. Instructional emphasis also prepares students with the knowledge and high-level skills necessary for future graduate study in environmental engineering.

Systems Engineering
Systems engineering prepares students, through an interdisciplinary approach, for understanding the technical aspects in engineering process and design. Systems engineering is a key component in systems implementation and management, as well as enabling the realization of successful engineering and technical systems. Improving business strategies of integrated systems requires a solid foundation of knowledge and skills in engineering, mathematics, computer modeling and networking, and operation research. According to the U.S. Department of Labor in the Occupational Outlook Handbook, 2016-17 Edition, employment of systems administrators is projected to grow 8% from 2014-2021, around the average rate for
all occupations. Demand for information technology workers is high and should continue to increase as companies invest in newer, faster networks. For those students who move towards the area of systems analyst or systems engineering, the job outlook is expected to grow much faster than average, at over 21% during the same period.

As West Virginia strives to diversify its economy, the need for qualified employees in these disciplines represents a potential area of employment growth for the state. The U.S. Department of Labor notes in its demographic data that West Virginia ranks below the median rate in the number of engineers for the location.

Relationship of Objectives to the Mission of the Institution

“Shepherd University, a West Virginia public liberal arts university, is a diverse community of learners and a gateway to the world of opportunities and ideas. We are the regional center for academic, cultural, and economic opportunity. Our mission of service succeeds because we are dedicated to our core values: learning, engagement, integrity, accessibility, and community.”

The Engineering Science program will support the University mission as follows:

- **Fulfill our duty to serve the community**: The proposed program would generate graduates with a well-rounded background in Engineering and Applied Sciences, thereby serving the workforce and the economy in West Virginia’s Eastern Panhandle and surrounding communities. There is a documented need for employees with a well-rounded exposure in Engineering and Applied Sciences.

- **Promote Core Values**: Because of the interdisciplinary nature of the program, students will have a diverse approach to their education, will be engaged through research, publishing and internship opportunities, and have access to this program enhanced by lower rates of tuition in West Virginia.

- **Enhance research and publishing capabilities**: Maintain resources and tools necessary to support research projects for faculty members and also involve undergraduate students. The results of this research will lead to publications in peer-reviewed journals and presentations at professional conferences. These professional scholarship outcomes also fulfill target metric areas in the WV-HEPC master plan for higher education, *Leading the Way*.

The Department of Computer Science, Mathematics and Engineering (CME) at Shepherd University currently offers an Industrial Mathematics Degree program that targets students with an aptitude towards research in Applied Mathematics and its connections to solving industrial problems. The CME department also offers degrees in both Computer Science and
Computer Engineering. The proposed Engineering Science program will engage potential students who are more inclined towards Engineering Sciences and the connections therein. This distinction is realized through the capstone course and/or co-op/internship opportunities where research projects will focus more on the application of intended student outcomes to solving problems that arise in the field of Engineering and Applied Sciences.

A degree in engineering science will also support Shepherd’s vision statement: “Shepherd – a premier liberal arts university. We will be a nationally respected community of learners where passion, purpose, and experience unite to inspire individuals to shape the world.”

The proposed degree in engineering science will serve the regional workforce by providing a broad liberal arts education, hands-on course work through group and individual laboratory projects, and various experiential, collaborative arrangements with government, business, and industry where students apply knowledge and skills in a real world environment. As the program grows, it will support ever-increasing numbers of research projects, faculty development opportunities, academic exchanges, and scholarly/creative presentations by both faculty and students.

**Special Features that Make the Institution a Desirable Place to Initiate a Program**
The location of Shepherd University is central to a variety of Federal agencies and private industries that require employees with an exposure to critical thinking, data analysis, and advanced problem-solving skills associated with a background in the Engineering Sciences. These critical skills are associated with the strong foundation provided in the University’s core curriculum, as well as advanced, specialized programs of study in the Arts and Humanities, Business and Social Sciences, Education and Professional Studies, and Natural Sciences and Mathematics. This is a solid foundation on which to build an integrative, interdisciplinary program in the area of engineering science.


The Department of Computer Science, Mathematics and Engineering has integrated multiple disciplines to include faculty in the areas of Computer Science, Mathematics and Engineering, making it easier to coordinate course offerings. The department’s long history of emphasizing undergraduate research has led to a variety of presentations and publications by students and faculty in existing programs such as Traditional Mathematics, Computer Sciences, and Computer Engineering, as well as those with interdisciplinary features. We are confident students in the quad-state area with the desire and motivation to pursue engineering and/or mathematics, coupled with an aptitude towards research and making interdisciplinary connections, will benefit from Shepherd’s proposed program in engineering science.
5.2.b. Brief Description of Program and Program Objectives

As stated in 5.2.a. under “educational objectives,” the proposed Engineering Science major is a 120-credit hour program designed to provide students with exposure to subjects that form the rudiments of engineering and the applied sciences. Please refer to this section for a more detailed description of the program. The program features two concentrations: systems engineering and environmental engineering. In addition to the required 42 credits of core curriculum courses, of which each concentration has some prescribed coursework, students in these concentrations take courses in mathematics, engineering, environmental science, computer information systems, and data analytics.

The B. S. in Engineering Science is intended to be a 120-credit comprehensive major with clearly defined program objectives:

- Provide students with an exposure to Engineering and Applied sciences through its curriculum building a strong foundation in Mathematics and Engineering, along with an emphasis on applications.
- Prepare students for industrial jobs either in manufacturing or research by exposing them to research-oriented projects during the Senior Capstone.
- Reveal to students the connections between concepts in Computer Science, Mathematics, Engineering, Business and Management.
- Prepare students with a comprehensive background in Engineering and Applied Sciences, giving students the flexibility to be trained for current and future industrial careers.
- Prepare students for graduate school by providing opportunities for undergraduate research and the presentation of their research results at professional conferences.
- Develop students’ abilities to apply mathematics, science and engineering knowledge.
- Apply systems design, conduct experiments, analyze and interpret data.
- Utilize the techniques, skills, and modern engineering tools necessary for engineering practice.
- Identify, formulate, and solve real-world engineering problems.
- Promote an ability to engage in life-long learning.

The expected program outcomes are as follows:
- Graduates will be well rounded, with exposure to courses in both mathematics and engineering, coupled with their application to Engineering Sciences and infused with a strong liberal arts core.
• The program will prepare students to pursue their personal journeys as critical thinkers and problem solvers in their respective careers as engineers and/or applied scientists.
• The program will prepare students to attend graduate school through their experience in research projects.
• The program will prepare students with sound theoretical backgrounds and also relevant applications and practices that arise in engineering and applied sciences.

5.2.c. The Institution will assure high quality standards for the program and maintain a continuing assessment of quality.

Shepherd University has a solid reputation for strong, rigorous undergraduate education, and The Princeton Review has rated Shepherd “a best southeastern college.” Shepherd professors are dedicated to high quality teaching, small classes, with a tradition of face-to-face instruction and open door advising.

Ensuring and maintaining high standards has been a strong focus of the CME department. For example, the standards in calculus and engineering courses have evolved to provide students with a deeper insight into the concepts involved in the fields of mathematics, physics and engineering. The CME faculty hold doctoral degrees or have extensive professional experience in multiple disciplines and industries, and are qualified to handle the necessary requirements of offering a quality program. Some examples are listed below:

• The CME chair, Reza Mirdamadi has worked with NASA (National Aeronautics and Space Administration) on projects involving fluid mechanics and thermodynamics for many years and has been instrumental in supporting both faculty and students in funded research projects from NASA.
• Dr. Weidong Liao and Dr. Osman Guzide hold doctoral degrees in computer engineering and are actively involved in undergraduate research through many professional publications and presentations. A joint research project includes investigating a new mathematical algebraic model for improving algorithm performance on interconnection networks and core processors.
• Dr. Qing Wang specializes in stability theory of ordinary differential equations and its relationships with real-life systems. She has also received West Virginia IDeA Network of Biomedical Research Excellence predominantly undergraduate institutions (WV-INBRE PUI) Research Award.
• Dr. Mohammadreza Ghahremani has a Ph.D. in computer and electrical engineering and is an active researcher in magnetic refrigeration. As part of his ongoing research on magnetic cooling technology and in collaboration with Institute for magnetics research,
he has made an experimental discovery on nanoparticles magnetic properties. His discovery has revealed that nanoparticles, as compared to their bulk counterpart, have a larger magneto caloric effect with less hysteresis. This is a critical advancement in the design of magnetic refrigeration systems and has an immediate application in the cooling of computer chips.

- Dr. Ralph Wojtowicz has comprehensive research interests that include (1) development and implementation of a logical reasoning system for the graphical knowledge representation system (sketches) that was presented at a conference at George Mason University last year and at NASA in the Fall of 2014, (2) development and implementation of distributed (map-reduce) algorithms with applications to category theory and abstract algebra, (3) the potential use of quantum computers to solve logical inference problems more efficiently than classical computers, and (4) likelihood ratio based methods with applications to mathematical finance.

- Dr. Zhijun Wang’s research includes numerical methods that solve differential equation based mathematical models, such as multiple-dimensional solution space search using parallel algorithms, numerical simulation techniques, genetic algorithms, and particle swarm optimization.

In essence, the department is a collection of experts, with proficiency in a variety of core disciplines in computer science, mathematics and engineering, committed to providing a high quality education. Hence, we have no doubt that standards will not only be maintained but also promoted through higher grading schemes and evaluations in the core courses.

**Assessment**

Shepherd University has a mature culture of assessment that is overseen by the Center for Teaching and Learning. Filing reports on a cyclical basis (1.5 year cycle), all academic programs are required to use both direct and indirect measures of assessment, with multiple intended student outcomes. The CME department is committed to continuous improvement and making data-driven decisions based on the results from the required assessment measures. In addition, we require current students to give a formal presentation to a panel of faculty members as part of the capstone project. In this presentation, the student’s knowledge and abilities are assessed by asking a variety of questions related to their capstone project and field of study. Faculty members also interview selected graduates from our degree programs to gather additional assessment information for the different programs in the department. Answers from such exit interviews have served as a valuable checkpoint towards evaluating and assessing the quality of courses. The department plans to implement these important evaluative measures for the engineering science program.
Curricula will be assessed annually by the faculty to ensure program goals are met. Students will also have an opportunity to assess classes and faculty through the student evaluation process noted in Shepherd’s faculty handbook (Reference link: http://www.shepherd.edu/employees/senate/documents/handbook.pdf). In addition, an annual exit survey will be completed to track the success of graduates and to maintain a viable connection with alumni. Professionals from the industry, acting in an advisory capacity, will also be invited to give feedback on the program and to suggest possible improvements based on the current need of potential employees. All these measures ensure program curricula objectives and goals and ever-changing student needs are met.

Meeting these goals will enable graduates of the proposed program to succeed in graduate schools and/or professional employment in the field.

In summary, the following set of methods will ensure achievements in all areas of assessment:

• As a new program, the department will assess its curriculum every year.
• Students will submit evaluations for each course within the major.
• The department will administer an annual exit survey to track the success of graduates and to maintain a viable connection with our alumni.
• Through the program review process, the department will evaluate the whole program every five years to ascertain currency of curricular offerings.
• The CME department already requires written and oral presentations in many courses in computer science, mathematics and engineering, as well as laboratory courses. The department will work to expand this measure to include the engineering science major.
• The courses in humanities, social sciences and management will ensure students have educational balance and possess the liberal learning outcomes desired by employers.
• The engineering capstone course will include analysis, design, technical computations, data acquisition, and scientific reasoning.
• The CME department requires students to utilize their knowledge in brain storming, problem solving, and teamwork, along with the background in Engineering Science to work on design projects which are part of our introductory engineering classes like Engineering static and dynamics.

Program Review
Shepherd University ensures the quality of its academic programs, its faculty, and curricula through regular assessment in cyclical program reviews. The Engineering Science major will be subject to the five-year programmatic review under the established requirements of the state and the institution. Assessment data is regularly collected and reported to the Center for
Teaching and Learning as a part of the internal review process. The five-year review process requires both internal self-review (self-study document) and external review by a qualified professional; these documents, in turn, are reviewed by the campus Program Review Committee, Provost, and institutional Board of Governors.

The Engineering Science major will also be evaluated at intervals along with other university programs by Shepherd’s regional accreditor, the Higher Learning Commission (HLC).
5.2.d. Other Institutions Offering Similar Programs

Currently there are no engineering science programs within a seventy-five mile radius of Shepherd University. Engineering Science is not a common program in major universities due to its interdisciplinary nature, and the lack of cohesiveness across the disciplines of computer science, mathematics and engineering. Because of our academic organization and structure, Shepherd University has a unique opportunity to provide a quality engineering program to potential students, as all three disciplines are housed in the same department (Reference link: http://www.shepherd.edu/cmeweb/).

Marshall University offers a B.S. in Engineering (BSE) housed in its College of Engineering and Information Technology. The BSE program at Marshall University has its focus on civil or mechanical engineering. As stated above, the three disciplines (Computer Science, Mathematics and Engineering) encountered in the Engineering Science degree program are not separate disciplines but are housed within a single department. Shepherd’s proposed Engineering Science degree program offers two concentrations: Systems Engineering and Environmental Engineering.

West Virginia University does offer a variety of engineering opportunities; however, it does not have a stand-alone environmental engineering program. Their engineering concentration is civil and environmental. Shepherd’s program would be the only stand-alone environmental engineering program in the state.

In the Washington-Baltimore area and beyond, there are a number of prestigious institutions that offer these concentrations at a much higher rate of tuition:

- **Systems Engineering**: Penn State University, Johns Hopkins University, Georgetown University, George Washington University, and George Mason University.
- **Environmental Engineering**: Johns Hopkins University, Morgan State University, University of Maryland, and Virginia Polytechnic Institute (VPI).

Shepherd’s unique location in the Eastern Panhandle offers an outstanding opportunity for not only students from West Virginia, but also from the quad-state region (MD, PA, VA, DC) to be a part of this proposed new degree program in engineering science, offered at an affordable rate of tuition [Reference Link: http://www.shepherd.edu/tuition-and-fees/].
5.2.e. Statement of societal, occupational, research, or public service needs that will be met, as well as anticipated student demand for the program, societal, occupational, research, or public service needs

The proposed Engineering Science program provides opportunity to recruit and retain students who wish to pursue a career in Applied Sciences and Engineering and remain at Shepherd University. These students may desire to remain in the area due to financial, familial or other preferences such as local internships opportunities. This program would allow students to complete a degree in Engineering Science directly related to the workforce needs of the Eastern Panhandle. The program will also utilize existing faculty expertise in engineering and the applied sciences across multiple disciplines in Shepherd’s School of Natural Sciences and Mathematics.

The applicant pools that will be specifically targeted by recruitment efforts for this program include, but are not limited to the following groups:

- Current Shepherd University students pursuing the engineering minor and core engineering requirements in the mathematics major would be the primary target population. Without this degree program, these students would need to transfer to other institutions to pursue a four-year degree in engineering. The proposed program would aid in retaining these students both at Shepherd and within the state.
- New students recruited to Shepherd University as mathematics majors with an interest in the engineering and applied sciences would also be a target audience. The program will be actively advertised to high schools to show prospective students that a variety of degree programs are available at Shepherd, which would allow them to remain in the region to complete the undergraduate degree.
- Students at local two-year institutions such as Hagerstown Community College and Blue Ridge Community and Technical College who wish to continue their studies to achieve a four-year degree also represent a potential pool of students. Working with the Office of Enrollment Management, faculty and administrators will develop articulation agreements (i.e., 2+2 programs) to coordinate curricula, allowing graduates of two-year institutions to easily transition into a four-year program at Shepherd.
- The Environmental Engineering concentration was eliminated in fall 2015 from the Institute of Environmental and Physical Sciences at Shepherd University. Currently there are over 20 students in that concentration. Offering this degree program with a concentration in Environmental Engineering provides a relevant baccalaureate degree in their academic area of interest.
**Student Demand for the Program**

Given the affordable tuition rates at Shepherd University, growth and expansion in the government and industrial sector in the quad-state area [noted in 5.2.a.], and the increasing student interest in the applied sciences and engineering, we anticipate a high demand for this program. As noted, Shepherd University is accessible to potential students both in the Eastern Panhandle of West Virginia and the surrounding region.

Shepherd University’s location is ideal for initiating an Engineering Science program. According to a recent study by the West Virginia Bureau of Business and Economic Research (Reference link: http://be.wvu.edu/bber/pdfs/BBER-2014-04.pdf), the counties surrounding Shepherd University (Jefferson and Berkeley) are expected to sustain continued growth in the future, continuing progress that has taken place over the last two decades. This has led to an increasing number of educational and employment opportunities for West Virginia residents. Many of these jobs are in the field of engineering and applied sciences, and there has been a strong demand for engineers, engineering management personnel, as well as for applied scientists in the area of manufacture and information technology. Employment opportunities remain strong for this discipline, with specializations like environmental and systems engineering having potential job rates higher than the national average for the next decade (Source: The U. S. Bureau of Labor Statistics, 2012).

The continued integration of computer technology in a variety of manufacturing settings will require current and future employees to have a strong foundation in the scientific and engineering principles behind the applications. The introduction and implementation of this program will fulfill the recent call by various civic and private groups like the Chamber of Commerce and Gateway New Economic Council to increase the number of highly skilled workers in the Eastern Panhandle of West Virginia and the region Shepherd University serves.

Shepherd University has the third highest economic impact among West Virginia’s four- and two-year colleges according to a study commissioned by the West Virginia Higher Education Policy Commission. The study, titled “The Economic Impact of Public Institutions of Higher Education in West Virginia,” shows that Shepherd’s economic impact on Berkeley and Jefferson counties is $91.1 million. Part of this study, which was conducted by the West Virginia University Bureau of Business and Economic Research, examined the economic impact of direct university expenditures like supplies and utilities, university payroll, and out-of-state student expenditures. The study showed that in fiscal year 2014, Shepherd had a total budget of $60.8 million and spent about $32.6 million on salaries and benefits for its 647 employees. (Reference Link: http://wvutoday.wvu.edu/n/2016/08/04/west-virginia-s-public-higher-education-institutions-have-2-7-billion-impact-on-state)
5.2.f. Additional Resources Needed to Offer the Program

Faculty
The department has recently added an Applied Mathematician and Computer Engineer to its faculty, in addition to the existing Engineers, Mathematicians and Computer Scientists. No additional faculty will be required to offer the Engineering Science program, as the courses in the proposed Engineering Science curriculum are currently part of existing programs. These courses are offered on a regular rotation to ensure students progress towards degree completion. The faculty members in the Department of Computer Science, Mathematics and Engineering, housed in the School of Natural Sciences and Mathematics, have the necessary academic and professional qualifications to teach the upper-division courses that are listed as part of the curriculum for the B.S. in Engineering Science (see Appendix A).

Facilities Requirements
Courses for the proposed Engineering Science major will be taught in facilities available to the School of Natural Sciences and Mathematics and the Department of Computer Science, Mathematics and Engineering. These facilities are adequate for the academic and laboratory requirements for the proposed Engineering Science program. This includes both instructional and laboratory space in the Byrd Science Center and Stutzman-Slonaker Hall. Classrooms vary in capacity and all are technologically outfitted with computer projection systems and web access. The CME department recently acquired a 3-D printer and a PNC machine that would further support the proposed Engineering Science program. The recent report for the Higher Learning Commission in March 2016 notes that there are 28 teaching and research labs for the natural sciences housed within the facilities listed above.

The department has two engineering labs and one mathematics lab with access to MATLAB (engineering software) and MAPLE (technical computing software for engineers). The engineering laboratories are also used for the Analog and Digital Electronics course. The department also has three laboratories used for computer programming, computer organization, and networking and security. In addition, our students are able to use two labs for experimenting robotics-centric design and programming. The facilities feature state-of-the-art equipment and are easily adapted to teaching all the courses necessary for the proposed Engineering Science program.

Library
The Shepherd University library currently subscribes to select IEEE (Institute of Electrical and Electronics Engineers) and ACM (Association for Computing Machinery) periodicals along with
the MAA (Mathematical Association of America) and AMS (American Mathematical Society) monthlies. There is no charge to the campus community for the use of these journals and also for online article searches. Public access computers in the library can be used to browse the Internet or for literature searches. In addition, the library provides for interlibrary loan on articles that are not available online or through journals in the library holdings.

Library staff includes the following, many of whom hold specialized credentials:

- Dean (Faculty Librarian);
- Four additional Faculty Librarians;
- One Staff Librarian (Archives);
- One part-time Staff Reference Librarian;
- One professionally credentialed Librarian in a paraprofessional position;
- One other FT paraprofessional;
- Two part-time PT paraprofessionals;
- One IT Assistant;
- Approximately 3.5 FTE of work-study student employees.

The online digital library is licensed for group membership so students and faculty have easy access to relevant publications while in the library, as well as remotely. Users have access to thousands of full-text journals from over 50 databases, including subscription databases such as LexisNexis and JSTOR. The library assesses no fees for online searches or for its interlibrary loan services. Librarians also teach a one-credit course titled “Research Methods and Information Retrieval” (LBSC 100).

Professional librarians are available to assist faculty and students for a total of about 56 hours a week. In addition to LBSC 100, there are regularly scheduled tours, workshops, and orientation sessions for those who need assistance in utilizing the library’s materials. Librarians offer tailored information literacy skills class sessions that focus on using the library’s databases for research assignments. These sessions are held in the library’s instruction lab enabling students to develop their online searching skills with the assistance of a librarian. The library is normally open 86 hours per week during the fall and spring semesters and has a computer-equipped workroom open 24 hours a day. The reference section of the library is typically open 56 hours weekly during the regular academic year. At present there are 33 reference lab computers and 8 public computers on the main floor of the library. The 24-hour room has 8 computers; the instruction lab 24, the third floor 10, and 38 are available for checkout.
5.2.g. Instructional Delivery Methodologies to Deliver the Program

For the proposed program, the intent is to use Shepherd University’s existing classroom facilities and laboratories for instructional delivery. The degrees of instructional technology will vary according to the needs of the courses in the curriculum listed in Appendix A. Faculty in the program will collaborate with local industry and graduate schools in the region to provide students opportunities such as internships, research projects, and REU (Research Experiences for Undergraduates) programs.

Courses in the proposed program will be delivered primarily in traditional face-to-face settings. Some hybrid and online formats for instructional delivery may be utilized as the program develops.

Summary
Shepherd University is poised to move forward with an interdisciplinary baccalaureate degree in engineering science; no additional facilities are needed at this time, and modest expenditures will be required for faculty and support services. Given its proximity to major metropolitan areas, Shepherd is an ideal location to build a program that will nurture students who recognize the growing importance of a broad-based and interdisciplinary engineering background. Because of its location, the University can leverage this advantage to obtain guest speakers, panelists, as well as internship and career opportunities. The proposed program will assist students in developing analytical and problem-solving skills that will lead to future professional careers in a variety of disciplines.
Appendix A: Curriculum
Shepherd University
Bachelor of Science, Engineering Science Degree
Proposed Curriculum

The proposed comprehensive major in Engineering Science requires a minimum of 120 credits, of which 42 credits must be earned in courses above the sophomore level. Students in this major will take fundamental as well as specialized courses in mathematics and engineering. In the first two years, the focus will be on building a strong foundation in those disciplines, along with the core curriculum courses required of all students. This is followed by specialized courses in mathematics and engineering in the junior and senior year. The proposed degree program will culminate with a capstone project in the senior year, which includes individual efforts along the guidelines of undergraduate research mentored by faculty members. The resulting outcome is expected to be a publication and/or presentation at a professional conference.

To graduate with a B.S. degree in Engineering Science, a cumulative GPA of 2.5 and a minimum grade of “C” in all core and elective courses are required.

Curriculum for Engineering Science – Environmental Engineering Concentration

Total hours required (including technical electives).................................120

Core Curriculum Requirements.........................................................................42 Hours

Specific Core Curriculum Requirements, 16 Hours

- ENGR 100 Freshman Seminar (1)
- ECON 205 Principle of Macroeconomics (3)
- MATH 207 Calculus I (4)
- ENVS 201 Foundations of Environmental Science I (3)
- ENVS 201L Foundations of Environmental Science I - LAB (1)
- ENVS 202 Foundations of Environmental Science II (3)
- ENVS 202L Foundations of Environmental Science II - LAB (1)

Environmental and Physical Science Requirements, 36 hours

- ENVS 341 Sustainable Energy and Lab (4)
- ENVS 390 - Geographic Information Systems (4)
- ENVS 441 Hydrology and Lab (4)
• PHYS 221, 221 L General Physics I (4)
• PHYS 221, 222 L General Physics II (4)
• PHYS 301 Energy (4)
• CHEM 207, 207 L General Chemistry I (4)
• CHEM 209, 209L General Chemistry II (4)
• CHEM 333, 333L Environmental Chemistry (4)

Mathematics and Engineering Requirements, 42 hours

• ENGR 101 - Engineering I (3)
• ENGR 102 - Engineering II (3)
• ENGR 221 - Introduction to Electrical Engineering (3)
• ENGR 222 - Electrical Engineering Laboratory (1)
• ENGR 241 - Engineering Statics (3)
• ENGR 242 - Engineering Dynamics (3)
• ENGR 243 – Mechanics of Materials (3)
• ENGR 301 - Engineering Thermodynamics + (3)
• OR ENGR 351 - Fluid Mechanics (3)
• MATH 208 - Calculus II (3)
• MATH 307 - Linear Algebra (3)
• MATH 310 - Differential Equations (3)
• MATH 314 – Statistics (3)
• MATH 329 - Mathematical Modeling + (3)
• +OR CPE 492 Cooperative Work Experience in Computer Science and Engineering (3)
• ENGR 489 – Capstone (1)
• ENGR 490 - Capstone II (2)
• PHYS 222L General Physics II Laboratory (1)
• CHEM 207 General Chemistry (3)

**Mathematics Requirements** ................................................................. ...........30 Hours

• MATH 208 Calculus II (4)
• MATH 254 Discrete Mathematics (3)
• MATH 307 Linear Algebra (3)
• MATH 309 Calculus III (4)
• MATH 310 Differential Equations (4)
• MATH 318 Numerical Analysis (3)
• MATH 321 Probability and Statistics (3)
• MATH 329 Mathematical Modeling (3)
• MATH 354 Operations Research (3)

**Engineering Requirements** ...........................................................................20 Hours

• ENGR 101 - Engineering I (3)
• ENGR 102 - Engineering II (3)
• ENGR 221 - Introduction to Electrical Engineering (3)
• ENGR 222 - Electrical Engineering Laboratory (1)
• ENGR 224 - Electrical Circuits (3)
• ENGR 225 - Electrical Circuits Laboratory (1)
• ENGR 300 - Introduction to Robotics (3)
• ENGR 489 - Engineering Capstone Project I (1)
• ENGR 490 - Engineering Capstone Project II (2)

**CIS Requirements** .........................................................................................21 Hours

• CIS 104 Introduction to CIS (3)
• CIS 211 Computer Language Concepts (3)
• CIS 287 System Analysis and Design (3)
• CIS 314 Advanced Computer Language Concepts (3)
• CIS 321 Data and File Structures (3)
• CIS 418 Management Information Systems (3)
• CIS 486 Software Engineering (3)

**Elective Courses** ..........................................................................................7 Hours

• ENGR 241 Engineering Statics (3)
• ENGR 242 Engineering Dynamics (3)
• ENGR 305 – Digital Logic Circuits (4)
• ENGR 350 - Robotics Seminar (Up to 4)
• ENGR 326 Linear Systems (3)
• CIS 310 Information Security (3)
• CIS 388 Database Management System (4)
• CIS 390 Operating System (3)
• CPE 234 Networking (3)
• CPE 386 Computer Organization (4)
• CPE 433 – Microprocessor Design (3)
• CPE 482 - Real Time and Embedded System Design (3)
• DATA 418 – Big Data Analytics (3)