

**MARYLAND HIGHER EDUCATION COMMISSION
ACADEMIC PROGRAM PROPOSAL**

PROPOSAL FOR

- NEW INSTRUCTIONAL PROGRAM
 SUBSTANTIAL EXPANSION / MAJOR MODIFICATION
 COOPERATIVE DEGREE PROGRAM
 WITHIN EXISTING RESOURCES or REQUIRING NEW RESOURCES

Garrett College

Institution Submitting Proposal

Fall 2016

Projected Implementation Date

Lower Division Certificate

Award to be Offered

Electro-Mechanical Technology Certificate

Title of Proposed Program

Suggested HEGIS Code

Suggested CIP Code

Business & Information
Technology

Dr. Qing Yuan

Dept. of Proposed Program

Name of Department Head

Dr. Michel Ouendeno

Contact Name

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Contact Phone Number

President/Chief Executive Approval

Signature and Date

Date Endorsed/Approved by Governing Board

Date

A. Centrality to institutional mission statement and planning priorities

The mission statement of Garrett College includes the following commitments:

1. To provide accessible, quality education in a supportive environment to a diverse student population through associate degrees and certificate programs.
2. To develop engaging, innovative and sustainable curricula, programs and initiatives that are responsive to changing and emerging employment opportunities for citizens of Garrett County and the surrounding region.

The addition of a lower division certificate program in Electro-Mechanical Technology supports these commitments, and also aligns with the College's institutional goal (Workforce Development) to support the economic development of Garrett County and the surrounding region by creating a skilled workforce through credit programs, as well as non-credit job readiness and workforce preparation courses and "develop and implement career laddering opportunities consisting of multiple pathways that will enable student populations to move from non-credit to credit educational offerings" (Garrett College FY2014-FY2016 Strategic Plan). The proposed program is also an extension of the College's offerings in science, technology, engineering, and mathematics (STEM), and is designed to provide training leading to the acquisition of advanced technical skills as well as training directed toward the application of new and emerging technologies.

The Electro-Mechanical Technology Certificate program is designed for students who plan to enter the workforce immediately upon graduation. The availability of this program will offer many advantages for students including: providing an avenue for students taking non-credit courses offered through the College's Continuing Education and Workforce Development division to transition into a credit certificate program; reducing costs by allowing Garrett County high school graduates to take advantage of the Garrett County Scholarship Program; decreasing student debt by decreasing the amount of student loans required to complete a degree or certificate; increasing the likelihood of persistence to program completion by simplifying the logistics of attending college; and opening up more employment opportunities for graduates in Garrett County, as well as regionally and nationally.

B. Curriculum design

The Electro-Mechanical Technology Certificate program is designed to provide instruction and other learning activities that will enable students to acquire a combination of both basic and more advanced technical skills that can be applied in a relatively wide range of manufacturing and other industrial settings. In addition to developing technical skill proficiency, the Electro-Mechanical curriculum also incorporates competency-based applied learning that contributes to higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills.

The content includes but is not limited to instruction in maintenance techniques, computer-aided drafting/design skills, technical communications, maintenance and operation of various industrial components, quality control and testing, material handling protocols, and proper usage of tools and instrumentation.

After successfully completing this program, the student will be able to perform the following:

- Demonstrate an understanding of industrial processes.
- Generate and interpret computer-aided drawings.
- Demonstrate a fundamental understanding of electronics and electricity.
- Demonstrate an understanding of industrial safety, health, and environmental requirements.
- Demonstrate proficiency in using tools, instruments and testing devices.
- Demonstrate basic troubleshooting skills.
- Demonstrate appropriate communication skills.
- Demonstrate appropriate math skills.
- Understand, operate, troubleshoot, and maintain pneumatic, hydraulic, and electro-mechanical components and/or systems.
- Analyze and interpret typical Programmable Logic Controller (PLC) ladder logic programs.
- Operate industrial automation systems.
- Troubleshoot industrial automation systems.
- Use proficiently human machine interfaces to operate automated systems.

a. Requirements: Electro-Mechanical Technology– Certificate (24 credits)

The following is a recommended sequence of courses for completing this program. Prerequisite course requirements and/or course availability may affect a student’s individual progress. Students should always consult an academic advisor to better understand typical course availability and individual program planning.

Table 1: Program of Study and Course Sequence

Required Courses (*New Courses)				
Example Sequence	Course Number	Course Title	Credits	New Course
First Semester (12 credits)	ELM101	Blueprint Reading & Solid Modeling	3	*
	ELM110	Mathematics for Electronics	3	*
	CIS110	Computer-Aid Drafting	3	
	ELM130	Introduction to Industrial Electronics	3	*
Second Semester (12 credits)	ELM120	Industrial Safety	3	*
	ELM140	Electro-Mechanical Systems	3	*
	ELM210	Introduction to Programmable Logic Controller (PLC)	3	*
	ELM230	Pneumatics and Hydraulics	3	*
Total Credits			24	

b. Course Descriptions

ELM101 - Blueprint Reading & Solid Modeling (3 credits)

This course provides a comprehensive engineering and manufacturing technology print reading course in which students acquire the theory and practice to read complete sets of working multi-view drawings, basic dimensioning, holes, fasteners, assemblies, and tolerance. Solid modeling software will be introduced with training of sketch demands, extruded boss/base features, drawing planes, fillets, chamfers, multi-view drawings, and dimensioning. Three dimensional assembly modeling will also be covered with emphasis on advanced mates, exploded views, and animation.

Prerequisite: *None*

ELM110 - Mathematics for Electronics (3 credits)

An introductory and essentials course of mathematical concepts and techniques applied to circuit analysis. Topics include basic arithmetic operations, number notation and operation, engineering quantities and units of measurements, algebra fundamentals, and solving equations. Emphasizes mathematical techniques used in DC/AC circuit analysis. Beginning with Ohm's and Kirchoff's Law to analyze basic circuits, the student learns circuit simplifications and solution techniques. Selected applications will be demonstrated to students via a lab environment.

Prerequisite: *Permission of the Instructor*

ELM120 - Industrial Safety (3 credits)

This course includes the OSHA 30-hour General Industry Safety and Health content. Students will also learn the requirements of general material handling and storage, as well as specifics in the storage, movement utilizing powered industrial trucks, combustibility issues of flammable materials, and handling and storage of non-compatible materials. Instruction in the conditions, operations and circumstances of fall protection systems and practices will be provided.

Prerequisite: *None*

ELM130 - Introduction to Industrial Electronics (3 credits)

This course provides an introduction to the basic fundamentals, terminology, and applications used in the electronic industry. The course has been designed for those students who need an understanding of electronic principles and applications but do not need the theoretical or mathematical depth required for electronic circuits design. The topic coverage will include circuit theory principles, electronic components, transistor usage, amplifiers, power supplies, digital logic techniques, and electronic instruments. This course will also include some basic laboratory exercises to strengthen the topic coverage as it pertains to basic measurement involving both analog and digital circuits.

Prerequisite: *ELM110c*

ELM140 - Electro-Mechanical Systems (3 credits)

This course is a study of the basic mechanical components in a complex electro-mechanical system. Topics covered include basic functions and physical properties of mechanical components and the roles they play in the system such as: materials, lubrication requirements, and surface properties; troubleshooting techniques and strategies to identify, localize, and correct malfunctions; and systemic preventative maintenance; and electrical and mechanical component safety. Technical documentation such as data sheets and specifications of mechanical elements will also be covered.

Prerequisite: *ELM130*

CIS110 – Computer-Aid Drafting (3 credits)

This course is designed to introduce students to Computer Aided Drafting. Basic CAD operations will be covered, along with terminology and applications. AutoCAD software will be used.

Prerequisite: *Permission of the Instructor or CIS105*

ELM210 - Programmable Logic Controllers (PLC) Fundamentals (3 credits)

An introduction to PLC terminology, input/output modules and memory, relay schematics and ladder logic diagrams and programming of programmable logic controllers covered and reinforced in practical laboratory experiments. Sensing devices as limit switches, on/off electrical devices, applications of industrial type PLCs requiring motion control are included.

Prerequisite: *ELM130*

ELM230 - Pneumatics and Hydraulics (3 credits)

This course is a study of fluid power technology using fluids or compressed air as the transfer media. Complete hydraulic and pneumatic systems are studied including power sources, reservoirs, pumps, compressors, lines, valves and actuators. Students will learn troubleshooting strategies to identify, localize, and correct malfunctions. Preventative maintenance and safety issues will also be discussed.

Prerequisite: *ELM130*

C. Critical and compelling regional or State-wide need

As called for in 2013-2017 Maryland State Plans for Postsecondary Education, increasing the number of STEM degrees and certificates awarded to students is another key goal for Garrett College. STEM-related occupations are critical because they are closely tied to technological innovation, economic growth, and increased productivity. Currently, workers with STEM competencies and degrees are in high demand.

Garrett College expects a demand for the program not only from new students, but also from people who are already employed in a manufacturing or other industrial facility, where there is a growing demand for workers with the skills that the Electro-Mechanical Technology program is designed to provide. Courses can be offered both day and evening, and in a variety of approaches: self-paced, computer-assisted, hands-on labs, and face-to-face with instructors. The program is designed for attracting, retaining, and graduating a more diverse population of students in STEM disciplines. One of the College's objectives is to cultivate, develop, and support a greater interest in STEM programs on the part of more women and racial and/or ethnic minorities.

D. Evidence and documentation of market supply & demand in the region and State

Many modern products and systems contain both electronic and mechanical parts, such as copiers, automobiles, and factory assembly lines. Electro-Mechanical technicians combine knowledge of mechanical technology with a knowledge of both electrical and electronic circuits. They install, troubleshoot, repair, and upgrade electronic and computer-controlled mechanical systems, such as

robotic assembly machines. In addition, they may operate unmanned submarines, aircraft, or other remote controlled equipment at worksites, such as oil rigs, deep ocean exploration sites, or hazardous waste removal sites.

a. Current Job Openings

Workforce data from the Department of Labor, Licensing and Registration (DLLR), for Western Maryland, shows opportunities for occupations involving Electro-Mechanical Technology. Western Maryland Workforce Investment Area (Western Maryland WIA) is a multi-county workforce region. It is comprised of Allegany, Garrett and Washington Counties.

Table 2: Industries by Advertised Job Openings as of Jan. 4, 2015

Rank	Industry	Number of Job Openings
1	Retail Trade	480
2	Administrative and Support and Waste Management	332
3	Health Care and Social Assistance	298
4	Transportation and Warehousing	285
5	Accommodation and Food Services	230
6	Manufacturing	209
7	Information	119
8	Professional, Scientific, and Technical Services	111
9	Finance and Insurance	92
10	Wholesale Trade	62

Companies in the region (within a 50-mile radius) that could potentially hire Electro-Mechanical technicians include: BOEING - *Smithfield, PA*; STERIS - *Morgantown, WV*; DRS Technologies - *Lemont Furnace, PA*; DRS Technologies - *Uniontown, PA*; Jamie and Associates - *Morgantown, WV*; ISS Solutions - *Morgantown, WV*; and Beitzel Corp. – *Grantsville, MD*.

Also, according to Bureau of Labor Statistics, <http://www.bls.gov/oes/current/oes173024.htm>, in May 2014, a total of 14,430 people were employed in Electro-Mechanical technician occupations. The mean annual wages was estimated to be \$55,600, based on the data shown in Table 3, below.

Table 3: Industries with the highest levels of employment in Electro-Mechanical Technicians

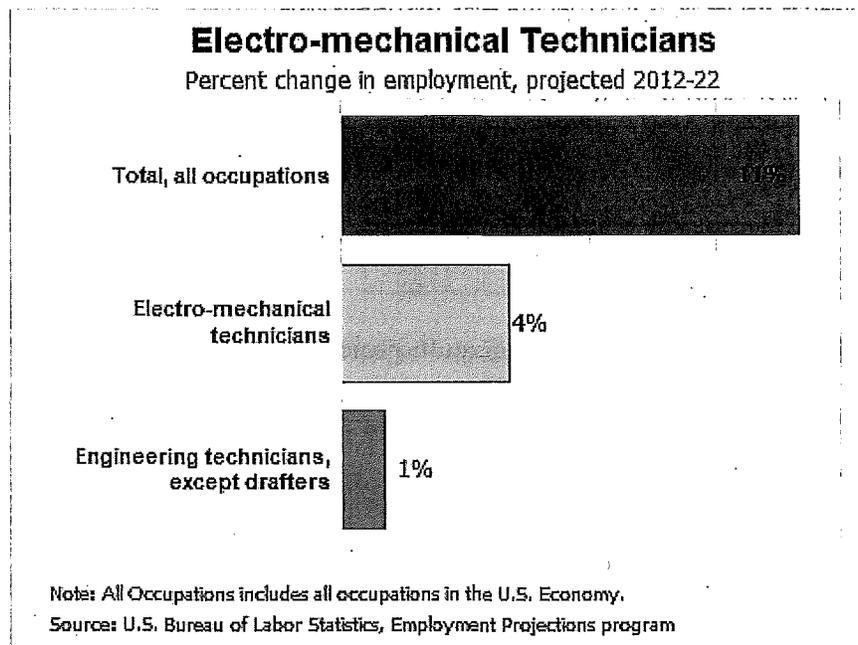
Industry	Employment	Hourly mean wage	Annual mean wage
Navigational, Measuring, Electro-medical, and Control Instruments Manufacturing	1,910	\$26.78	\$55,700
Architectural, Engineering, and Related Services	1,700	\$27.27	\$56,720
Semiconductor and Other Electronic Component Manufacturing	1,280	\$25.95	\$53,970
Support Activities for Mining	1,060	\$21.31	\$44,320

Scientific Research and Development Services	830	\$32.25	\$67,070
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b. Future Job Growth

According to the Bureau of Labor Statistics, employment of Electro-Mechanical technicians is projected to grow 4 percent from 2012 to 2022; this is summarized in Figure 1. <http://www.bls.gov/ooh/architecture-and-engineering/electro-mechanical-technicians.htm#tab-6>

Figure 1: Job Outlook for Electro-Mechanical Technicians



Electro-Mechanical technicians held about 17,300 jobs in 2012, <http://www.bls.gov>. The industries that employed the most electro-mechanical technicians in 2012 were as follows:

Architectural, engineering, and related services	13%
Navigational, measuring, electro-medical, and control instruments manufacturing	11%
Semiconductor and other electronic component manufacturing	10%
Scientific research and development services	8%
Support activities for mining	7%

Table 4: Employment projections data for Electro-Mechanical Technicians, 2012-22; Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2014-15 Edition*, Electro-mechanical Technicians

Occupational Title	SOC Code	Employment, 2012	Projected Employment, 2022	Change, 2012 - 2022	
				Percent	Numeric

Electro-Mechanical Technicians	17-3024	17,300	18,000	4	700
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c. Electro-Mechanical Certificate Graduates

According to the Bureau of Labor Statics, "...as demand increases for engineers to design and build new equipment in various fields, employment of electro-mechanical technicians should also increase. This will be seen in new applications designed by engineers to automate more processes within manufacturing and other sectors."

It is expected that the specialized Electro-Mechanical Technology certificate program at Garrett College will not only attract new students who plan to enter the workforce immediately upon graduation, but also people who are already employed in a manufacturing or other industrial facility more training. Tables 5 and 6 show projected enrollments and graduates, respectively, for the Electro-Mechanical Technology Certificate.

Table 5: Electro-Mechanical Technology Certificate Enrollment Projections

	FY2016	FY2017	FY2018	FY2019	FY2020
Full-Time	5	10	10	15	15

Table 6: Electro-Mechanical Technology Certificate Graduation Projections

FY2017	FY2018	FY2019	FY2020
5	8	10	15

d. Sources and Summary

- **Table 2**, above summarizes the job openings in Western Maryland, January 4, 2015, <http://www.dllr.state.md.us/lmi/https://mwejobs.maryland.gov/analyzer/default.asp?fromaltntry=1>
- **Table 3**, indicates industries with the highest levels of employment in Electro-Mechanical Technicians in May 2014, with 14,430 employments and the mean annual wages were estimated at \$55,600 for Electro-Mechanical Technicians occupations, <http://www.bls.gov/oes/current/oes173024.htm>,
- **Table 4**, employment projections for Electro-Mechanical Technicians, <http://www.bls.gov>
- **Table 7**, below, trends in Electro-Mechanical Technology related programs in Maryland institutions.

E. Reasonableness of program duplication

The Electro-Mechanical Technology certificate program is closely related to programs in Mechatronics. The institutions offering related programs are listed below in Table 7.

Table 7: Related Programs in Maryland

Institution	Program Name	Degree Offered
Anne Arundel Community College	MECHATRONICS TECHNOLOGY	Lower Division Certificate
Anne Arundel Community College	MECHATRONICS TECHNOLOGY	Associate Degree
Baltimore City Community College	ROBOTICS/MECHATRONICS TECHNOLOGY	Associate Degree
University of Maryland, Baltimore County	MECHATRONICS	Post-Baccalaureate Certificate

F. Relevance to Historically Black Institutions (HBIs)

No impact on HBIs is anticipated from this new program.

G. Distance education program

N/A.

H. Adequacy of faculty resources

- Just one faculty member listed

Garrett College has a strong faculty team consisting of both full-time and part-time faculty members. The following is a list of the faculty members who will be teaching the required courses for the certificate program:

FT: Faculty
Michel Ouendeno, Full-time Assistant Professor in Electrical Engineering program, has BSEE from University of Central Florida, Orlando; MSEE and Ph.D. from Florida Institute of Technology, Melbourne, Florida. Dr. Ouendeno will be the program coordinator and principal instructor for the Electro-Mechanical Technology certificate program. Dr. Ouendeno has extensive experience in industry as well as academia.

I. Adequacy of library resources.

The Library at Garrett College offers extensive resources for academic research with a large collection that includes books, periodicals, electronic journals, newspapers, audio books, CDs, videos, and DVDs. In addition to student computer workstations with Microsoft Office products and Internet access for academic projects, the GC library offers extensive services to students including, but not limited to the following: multiple electronic databases including Maryland Digital Library, Pro=Quest, Science Resource Center, and Access Science; on-campus access and 24-hour remote access; Citation Machine, an on-line service that assists students in the location and citation of sources to support literature research; and access to materials from other Maryland public and university libraries, the library of West Virginia University, and the Library of Congress through interlibrary loan and a variety of virtual libraries. It is anticipated that the above listed resources will be sufficient in terms of learning resources for Electro-Mechanical Technology certificate students. Learning resource requirements will be assessed annually to determine whether additional reference or library resources may be needed.

J. Adequacy of physical facilities, infrastructure and instructional equipment

Garrett College's Engineering/Robotics laboratory is adequate to support the new Electro-Mechanical Technology program. The laboratory has an electronics equipment setting, Majo3D printer with Solidworks software, and MecLab Technology training equipment from Amtek Company, Inc, <http://www.amtekcompany.com/technical-training-equipment-2/mechatronics/>. The laboratory is able to accommodate up to 20 students.

K. Adequacy of financial resources

Table 8 summarizes resource estimates in each of the following categories over the first 5 years of program implementation:

1. Reallocated Funds: N/A
2. Tuition and Fee Revenue: Includes payments directly attributable to students new to the institution enrolled in this program each year. The total revenue was estimated based on cost to in-county and West Virginia reciprocity students only at the credit hour rate of \$128.00 (\$98.00/credit tuition plus \$30.00/credit hour supports the instructional, technological, and student services), plus \$25 registration fee/semester. All the cost is based on the current rate of tuition and fees. The full-time cost estimate is based on 12 credits per semester, for a total of 24 credits per year, while the part-time estimate is based on 6 credits per semester and a total of 12 credits per year.

Annual Tuition fee rate for full-time is calculated as: $(12 * (\$98+\$30) +\$25)*2 = \$3,122$

3. Grants and Contracts:
4. Other Sources:

Table 8: Resources

Resource Categories	FY2016	FY2017	FY2018	FY2019	FY2020
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c + g below)	\$23,290	\$41,972	\$46,580	\$62,190	\$69,870
a. Number of F/T Students	5	10	10	15	15
b. Annual Tuition/Fee Rate	\$3,122	\$3,122	\$3,122	\$3,122	\$3,122
c. Total F/T Revenue (a x b)	\$15,610	\$31,220	\$31,220	\$46,830	\$46,830
d. Number of P/T Students	5	7	10	10	15
e. Credit Hour Rate	\$128	\$128	\$128	\$128	\$128
f. Annual Credit Hour Rate (# of credits earned)	12	12	12	12	12
g. Total P/T Revenue (d x e x f)	\$7,680	\$10,752	\$15,360	\$15,360	\$23,040
3. Grants, Contracts & Other External Sources	N/A	N/A	N/A	N/A	N/A
4. Other Sources	N/A	N/A	N/A	N/A	N/A
TOTAL (Add 1 – 4)	\$23,290	\$41,972	\$46,580	\$62,190	\$69,870

Table 9 summarizes expenditure estimates for the following categories over the first 5 years of the program:

1. New Faculty: N/A
2. New Administrative Staff: N/A
3. New Support Staff: N/A
4. Equipment: The equipment budget will be used to improve the hardware and software in the lab.
5. Library: N/A
6. New and/or Renovated Space: N/A
7. Other Expenses: Since this program requires the faculty to have up-to-date technical skills, it is necessary for the faculty to attend training each year for new technology; also, there will be fees for equipment maintenance.

Table 9: Expenditures

Expenditure Categories	FY2016	FY2017	FY2018	FY2019	FY2020
1. Faculty (b + c below)	\$7,458.9	\$7,458.9	\$7,783.2	\$7,783.2	\$7,783.2
a. # FTE	NA	NA	NA	NA	NA
b. Total Salary	\$6,900	\$6,900	\$7,200	\$7,200	\$7,200
c. Total Benefits	\$558.9	\$558.9	\$583.2	\$583.2	\$583.2
2. Admin Staff (b + c below)					
a. # FTE	0	0	0	0	0
b. Total Salary					
c. Total Benefits					
3. Support Staff (b + c below)	N/A	N/A	N/A	N/A	N/A
a. # FTE	N/A	N/A	N/A	N/A	N/A
b. Total Salary	N/A	N/A	N/A	N/A	N/A
c. Total Benefits	N/A	N/A	N/A	N/A	N/A
4. Equipment	\$20,000	\$10,000	\$4,000	\$4,000	\$4,000
5. Library	N/A	N/A	N/A	N/A	N/A
6. New or Renovated Space	N/A	N/A	N/A	N/A	N/A
7. Other Expenses	\$4,000	\$4,000	\$3,000	\$3,000	\$3,000
TOTAL (Add 1 – 7)	\$31,458.9	\$21,458.9	\$14,783.2	\$14,783.2	\$14,783.2

L. Adequacy of provisions for program evaluation

Garrett College has identified student learning outcomes for all of its programs. The degree to which students achieve these learning outcomes is assessed annually as part of an annual program review process. Based on the fact that the Electro-Mechanical Technology certificate is a career-oriented program, the focus will be on the acquisition of the technical skills needed for students who wish to enter the Electro-Mechanical Technicians field or who wish to pursue career advancement. The College also employs a formal program review process wherein each of its academic and career programs are formally reviewed on a regular cycle (every three years for computer and information technology programs). In addition to the program data, this review takes into account information on faculty performance and all costs related to the program. Student learning outcomes are also assessed at the course-level within each program.

M. Consistency with the State's minority student achievement goals

1. The College actively recruits in urban areas with large minority populations and approximately 31% of the current student body is comprised of minority students.

2. The College is currently in discussions with Frostburg State University to explore the possibility of forming a cooperative agreement whereby Garrett College could increase its recruitment of international students.
3. The College is also in the process of identifying a Diversity Officer who will provide support to minority students in an effort to increase their retention.

N. Relationship to low productivity programs

The proposed program is not directly related to an identified low productivity program identified by the Commission.

