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April 4, 2022

James D. Fielder, Jr. Ph.D.  
Secretary of Higher Education  
Maryland Higher Education Commission  
6 North Liberty Street  
Baltimore, MD 21201

RE: New Academic Program Proposal - Master of Science in Internet of Things & Internet Technologies

Dear Secretary Fielder,

Please find enclosed a proposal to offer a new program at Bowie State University, for a Master of Science degree in Internet of Things & Internet Technologies, at (HEGIS 799.00 / CIP 11.0900).

The Department of Technology & Security at Bowie State University (BSU) proposes a 36-credit master's degree in Internet of Things & Internet Technologies (IoT&IT). The main idea behind IoT&IT is to collect and share data and connect components through the internet. The Internet of Things is used across many industries, ranging from healthcare to agriculture. The IoT&IT master's program will equip students with the knowledge, skill, and hands-on experience to implement, configure, and manage IoT systems.

Students who complete this master's program will have the ability to build hardware and software and implement solutions to security issues associated with IoT&IT devices. Students will also learn forward-thinking IoT&IT principles, preparing them to be experts in their field. These programming, cybersecurity, and hardware design skills can be applied to an extensive range of IoT careers, yielding lucrative positions in energy, transportation, and medicine, such as cloud solutions architect, cloud engineer, systems engineer cloud computing, network IoT cloud engineer, IoT engineer, information security analysts, computer network architect, 5G edge computing and mobile edge computing, as well as future positions that may not exist today.

We respectfully request the Commission's consideration of this proposal.

Sincerely,

Aminta H. Breaux

Cc: Dr. Carl B. Goodman, Provost and Vice President for Academic Affairs  
Dr. Joann Boughman, Senior Vice Chancellor, USM  
Dr. Antoinette Coleman, Associate Vice Chancellor, USM  
Dr. Lethia Jackson, Department Chair, Technology and Security  
Dr. George Acquah, Dean, College of Arts and Sciences  
Ms. Gayle Fink, Assistant Vice President, Office of Planning, Analysis and Accountability



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**Cover Sheet for In-State Institutions  
New Program or Substantial Modification to Existing Program**

Institution Submitting Proposal	Bowie State University
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*Each action below requires a separate proposal and cover sheet.*

- |   |   |
|---|---|
| <input checked="" type="radio"/> New Academic Program | <input type="radio"/> Substantial Change to a Degree Program            |
| <input type="radio"/> New Area of Concentration       | <input type="radio"/> Substantial Change to an Area of Concentration    |
| <input type="radio"/> New Degree Level Approval       | <input type="radio"/> Substantial Change to a Certificate Program       |
| <input type="radio"/> New Stand-Alone Certificate     | <input type="radio"/> Cooperative Degree Program                        |
| <input type="radio"/> Off Campus Program              | <input type="radio"/> Offer Program at Regional Higher Education Center |

Payment <input type="radio"/> Yes	Payment <input checked="" type="radio"/> R*STARS #	Payment	Date
Submitted: <input type="radio"/> No	Type: <input type="radio"/> Check #	Amount: \$850.00	Submitted: 04/04/2022

Department Proposing Program	Department of Technology & Security		
Degree Level and Degree Type	Master of Science		
Title of Proposed Program	Internet of Things & Internet Technologies		
Total Number of Credits	36		
Suggested Codes	HEGIS: 799.00	CIP: 11.0900	
Program Modality	<input type="radio"/> On-campus	<input checked="" type="radio"/> Distance Education (fully online)	
Program Resources	<input type="radio"/> Using Existing Resources	<input type="radio"/> Requiring New Resources	
Projected Implementation Date	<input type="radio"/> Fall	<input checked="" type="radio"/> Spring	<input type="radio"/> Summer Year: 2023
Provide Link to Most Recent Academic Catalog	URL:		
Preferred Contact for this Proposal	Name:	Dr. Lethia Jackson	
	Title:	Professor Chairman	
	Phone:	(301) 860-3970	
	Email:	ljackson@bowiestate.edu	
President/Chief Executive	Type Name:	Aminta H. Breck	
	Signature:	<i>Aminta H. Breck</i>	Date: 4-4-22
	Date of Approval/Endorsement by Governing Board:		

Revised 1/2021

## Bowie State University

### Master's Degree in Internet of Things & Internet Technologies New Program Proposal

The Department of Technology & Security at Bowie State University (BSU) proposes a 36-credit master's degree in Internet of Things & Internet Technologies (**IoT&IT**). The main idea behind **IoT&IT** is to collect and share data and connect components through the internet. The Internet of Things is used across many industries, ranging from healthcare to agriculture. The **IoT&IT** master's program will equip students with the knowledge, skill, and hands-on experience to implement, configure, and manage IoT systems.

Students who complete this master's program will have the ability to build hardware, software and implement solutions to security issues associated with **IoT&IT** devices. Students will also learn forward-thinking **IoT&IT** principles, preparing them to be experts in their field. These programming, cybersecurity, and hardware design skills can be applied to an extensive range of IoT careers, yielding lucrative positions in energy, transportation, and medicine such as: cloud solutions architect, cloud engineer, systems engineer cloud computing, network IoT cloud engineer, IoT engineer, information security analysts, computer network architect, 5G edge computing and mobile edge computing, as well as future positions that may not exist today.

#### A. Centrality to Institutional Mission and Planning Priorities:

*Provide a description of the program, including each area of concentration (if applicable) and how it relates to the institution's approved mission.*

The Bowie State University, Department of Technology & Security proposes a Master of Science degree in **IoT & Internet Technologies (IoT&IT)**. Smart devices now carry out more activities/tasks than ever before, and current IT devices will need to be linked to these smart devices. Smart devices have been designed and implemented in isolated disciplines (e.g., computer science and engineering), but the need for current IT devices to link to the smart devices requires a new approach to IoT. This new approach requires the need to appropriately blend disciplines to focus primarily on the essential challenges of IoT: 1) IoT development, 2) IoT deployment, 3) IoT convergence, 4) IoT security, and 5) IoT cross-pollination across disciplines. The **IoT&IT** program will provide in demand technology-driven skills that turn data into intelligence. Graduates build an ecosystem of hardware, software, and services, that leads to careers in a technology-based industry that seeks smart intelligence areas such as smart energy, smart homes, smart transportation, and smart medical devices. This program focuses on device/product development, research, issues regarding machine-to-machine connectivity and communication and privacy to meet this evolving research area to meet the marketplace.

Graduates of the master's program in **IoT&IT** will:

- Diagram and build IoT machines and ecosystems models with existing and emerging hardware and software entities.
- Reconstruct models to customize and maintain state-of-the-art IoT devices, internet technologies, and networks.
- Investigate and weigh data-driven decisions linking current IT infrastructure to emerging IoT infrastructure.
- Select and differentiate IoT applications, internet technologies, and protocols commonplace to the industry.
- Evaluate the legal and ethical implications of their work and the impact of decision-making in industry and the community.

*Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.*

The proposal is aligned with BSU's mission to empower a diverse population of students to reach

prepare for careers, civic responsibility, and lifelong learning.<sup>1</sup> The program also contributes to the achievement of Bowie State University's FY 2019 – FY 2024 *Racing to Excellence* Strategic Plan, particularly Goal 1 Academic Excellence, Objective 1.1: High-demand, innovative academic programs.

The University System of Maryland (USM) offers a world-class education to students as they prepare for careers, lifelong learning, and civic responsibility. The **IoT&IT** program is proposed to support the USM's mission to provide high-quality and affordable academic programs and increase student retention and completion rates.<sup>2</sup> Additionally, the **IoT&IT** proposal aligns to support the priority goal in BSU's strategic plan for the years 2019-2024 and enables the institution to continue to support educational opportunities for Marylanders (Success, Strategy 4) to engage in a continuous improvement process to ensure that institutional policies and practices support student success (Success, Strategy 5), provide alternative modalities, new programs and pedagogies, and streamlined student and academic support services to facilitate timely degree completion (Success, Strategy 6) (Innovation, Strategy 9), integrate high impact practices into the student experience, including career advising and planning into internship experiences (Success, Strategy 7), partner with business, government and other institutions to support workforce development and graduate readiness (Innovation, Strategy 8), and expand support for grant participation and research (Innovation, Strategy 10).<sup>3</sup> This program targets the demand for qualified science, technology, engineering, and math (STEM) graduates who can accelerate innovation and growth to further the STEM workforce sectors through advanced skillsets gained through graduate education.

*Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L).*

The **IoT&IT** Master of Science program will be funded for at least five years through the support of BSU's administration commitment to comply with ABET's accreditation requirements for the CTEC program which include the following:

- New equipment/refresh equipment for all labs supported under the Department of Technology & Security
- A full-time System Administrator to support instructional classrooms/laboratories and faculty research areas (labs).
- Two full-time faculty positions (according to ABET recommendation for the undergraduate program).

The Computer Technology (CTEC) Program is accredited and is seeking renewed accreditation from ABET spring 2022.

To support the master's program, the department is requesting one additional full-time faculty designated to the graduate program. Thus, yielding three new full-time faculty (two undergraduate faculty, one graduate faculty).

During the 16-week academic semester there are two eight-week sessions. The courses in the Department of Technology & Security are all taught in eight-week sessions (2 per academic semester).

According to the *Fall 2021 Enrollment by Undergraduate Program* report prepared by BSU's Office of Planning, Analysis, and Accountability (OPAA), enrollment numbers continue to grow in the CTEC undergraduate program (see Appendix A). According to a report, prepared by the Registrar's Office, the *CAS Fall 2021 Graduates* report, the CTEC program graduated 40 students in Fall 2021 (See Appendix B).

Based on the current enrollment and graduation numbers, the full-time faculty teach, on average, two

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<sup>1</sup> <https://bowiestate.edu/about/at-a-glance/mission-and-vision.php>

<sup>2</sup> [https://www.usmd.edu/about\\_usm/](https://www.usmd.edu/about_usm/)

<sup>3</sup> <https://bowiestate.edu/about/administration-and-governance/office-of-the-president/strategic-plan/>

overload courses and adjunct faculty, on average, teach three courses each 8-week academic sessions.

Therefore, the graduate program will be implemented in a cohort model. The cohort model is designed to offer the same two graduate courses per designated 8-week session every academic year.

Students enter the cohort model in AY 2022 Fall 8 week 1. The next pair of courses will be taught 8 week 2 and so on. Based on the aforementioned report, the department anticipates the same growth in the graduate program as in the undergraduate program. Henceforth requesting one new faculty position to support the graduate program.

The workload will be altered with full-time faculty (FT) teaching three undergraduate courses with at least one graduate course or FT teaching four undergraduate courses and no graduate courses. With the addition of three new full-time faculty (NFT) teaching four undergraduate courses and no graduate courses or NFT teaching four graduate courses and no undergraduate courses.

	FT1	FT2	FT3	FT4	FT5	FT6	NFT1	NFT2	NFT3
Under grate course taught	3	3	3	4	3	4	4	4	0
Grad course 1 - (fall 2022 8 week 1)	1								
Grad course 2 - (fall 2022 8 week 1)		1							
Grad course 3 - (fall 2022 8 week 2)			1						
Grad course 4 - (fall 2022 8 week 2)					1				
Grad course 5 - (spring 8 week 1)									1
Grad course 6 - (spring 8 week 1)									1
Grad course 7 - (spring 8 week 1)									1
Grad course 8 - (spring 8 week 1)									1
Grad course 9 Capstone I (Summer S1)					1				
Grad course 10 Capstone 2 - (Summer S2)					1				
Grad course 11 Thesis 1- (Summer S1)	1								
Grad course 12 Thesis 2 - (Summer S2)	1								

Note:1. Whenever reallocated funds are included among the resources available to new programs, the following information must be provided in a footnote: origin(s) of reallocated funds, the impact of the reallocation on the existing academic program (s), and how the reallocation is consistent with the institution's strategic plan.

<sup>2</sup> This value represents 65% of the projected total Tuition & Fee revenues for Full Time & Part Time students

<sup>3</sup> Tuition Rate is based on the FY 2020 Proposed Tuition & Rate Schedule with a 3% increase in the subsequent years.

<sup>4</sup> Credit Hour Rate is based on the FY 2020 Proposed Tuition & Rate Schedule with a 2% increase next year.

<sup>5</sup> Whenever external funds are included among the resources, the following information must be provided in a footnote: source of the funding and alternative methods of funding the program after the cessation of external financing. Title III Funding is anticipated to begin the program and is expected through subsequent years.

2. Complete **Table 2: Program Expenditures and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also, provide a narrative rationale for each, 575 expenditure category.

The table includes the cost for the undergraduate program and the master's program since all faculty are involved in both programs. The table estimates salaries and fringe benefits for six full time faculty and three new full-time faculty positions. Expenditure category #1 gives the total salaries for all faculty teaching in the Department of Technology & Security. Expenditure category #2 gives the estimated total salary for the administrative staff. Expenditure category #3 gives the estimated total salary for a full-time system administrator. Expenditure category #4 consists of the estimated cost to provide new equipment or equipment refresh for 100 computers which covers three laboratory environments (See Appendix C). The refresh will occur every three years to maintain equipment that will extend research, computing, software, and hardware capabilities. Expenditure category #5 is an estimate to obtain library resources for research, capstone projects, and off the shelf purchased online resources that covers course content.

TABLE 2: EXPENDITURES					
<i>Expenditure Categories</i>	<i>(Year 1)</i>	<i>(Year 2)</i>	<i>(Year 3)</i>	<i>(Year 4)</i>	<i>(Year 5)</i>
1. Total Faculty Expenses (b + c below)	\$804,449.04	\$820,568.33	\$836,979.98	\$853,719.57	\$870,793.96
a. # FTE	12	12	12	12	12
b. Total Salary <sup>6</sup>	\$744,888	\$759,785.76	\$774,981.47	\$790,481.09	\$806,290.71
c. Total Benefits <sup>7</sup>	\$59,591.04	\$60,782.86	\$61,998.51	\$63,238.48	\$64,503.25
2. Total Administrative Staff Expenses(b + c below)	\$60,480	\$62013.60	\$62,923.39	\$64,181.85	\$65,465.49
a. overload/adjunct pay <sup>8</sup>	\$39,000	\$39,901	\$40,575	\$41,387	\$42,214.85
b. Total Salary <sup>9</sup>	\$56,000	\$57420	\$58,262.40	\$59,427.64	\$60,616.20
c. Total Benefits <sup>10</sup>	\$4480	\$4,593.60	\$4,660.99	\$4,754.21	\$4,849.26
3. Total Support Staff Expenses (b + c below)	\$91,800	\$93,636	\$95,508.72	\$97,418.89	\$99,367.26
a. # FTE	1	1	1	1	1
b. Total Salary <sup>11</sup>	\$85,000	\$86,700	\$88,434	\$90,202.68	\$92,006.73
c. Total Benefits <sup>12</sup>	\$6,800	\$6,936	\$7,074.72	\$7,216.21	\$7360.53
4. Equipment/Refresh 100 computers with monitors (See Appendix	\$271,308			\$271,308	

C)					
5. Library	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
<b>TOTAL (Add 1 - 7)</b>	<b>\$1,180, 237</b>	<b>\$826029.56</b>	<b>\$945,478.37</b>	<b>\$1,235,596.40</b>	<b>\$983,474.30</b>

<sup>6</sup> Average Course Overload Salary for Assistant Professors in DTS for FY 2021 with a 2% increase in subsequent years.

<sup>7</sup> Fringe Benefits for Assistant Professors in DTS for FY 2021 is 8% of Salary with a 1% increase in subsequent years. (Notes: There are no benefits associated with course overload salaries during the semester. In the summer months, the benefits rate associated with course overload is 8%.)

<sup>8</sup> Estimated overload and adjunct pay at \$6,500 \* 12 courses in the master's program

<sup>9</sup> Administrative Assistant II in FY 2021 with a 2% increase in subsequent years.

<sup>10</sup> Fringe Benefits for Administrative Assistant II in FY 2021 is 8% of Salary

<sup>11</sup> Average Salary for System Administrator in FY 2021 with 2% increase in following years

<sup>12</sup> Fringe Benefits for Lab Technician in FY 2021 is 8% of Salary.

*Provide a description of the institution's commitment to:*

a) *ongoing administrative, financial, and technical support of the proposed program*

The BSU administration has pledged commitment to the development and sustainability of the **IoT&IT** master's program. The university's policy is to support innovative programs by providing funds to hire new faculty, support the development of new courses, and provide additional library resources. The **IoT&IT** master's degree program will be the only program of its kind in the USM or at other HBCUs. The administration is prepared to support the effort as demonstrated by the administration's commitment to the ABET accreditation of the Department of Technology & Security program. The support provided by administration to meet ABET accreditation will extend to support the **IoT&IT** program (equipment, laboratories, research facilities, personnel, etc.). The BSU administration has committed to the hiring of talented faculty, equipment refresh for all instructional classrooms, and laboratories to support the **IoT&IT** program. The workload will be altered with full-time faculty (FT) teaching three undergraduate courses with at least one graduate course or FT teaching four undergraduate courses and no graduate courses. With the addition of three new full-time faculty (NFT) teaching four undergraduate courses and no graduate courses or NFT teaching four graduate courses and no undergraduate courses.

b) *continuation of the program for a period of time sufficient to allow enrolled students to complete the program.*

The continuation of the program for a period sufficient to allow enrolled students to complete the program will be provided through a cohort model. The benefits of a cohort model are students are in a community of learning with a shared goal to progress through the program. The cohort model "fosters creativity, builds leadership skills, generate a sense of community, and proceed at a predetermined pace."<sup>4</sup> Each semester, only courses for the cohort will be offered for the new degree program. This model allows for a faculty workload to be considered as well as considering time toward graduation for the students. Therefore, the courses will be offered according to two considerations: 1) faculty load, and 2) the courses needed to progress students towards graduation. The workload will be altered with full-time faculty (FT) teaching three undergraduate courses with at least one graduate course or FT teaching four undergraduate courses and no graduate courses. With the addition of three new full-time faculty (NFT) teaching four undergraduate courses and no graduate courses or NFT teaching four graduate courses and no undergraduate courses.

<sup>4</sup> <https://www.ramapo.edu/articles/cohort-mba/>

## **Critical and Compelling Regional or Statewide Need as Identified in the State Plan:**

1. *Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:*

a) *The need for the advancement and evolution of knowledge*

Presently, human beings are not the only talking objects. IoT devices “talk” to each other through complex wireless networks that involve the internet, cloud computing, data science, artificial intelligence, and machine learning; this affects our physical world. “Smart” things such as watches, phones, cameras, home security systems, autonomous vehicles, and even home appliances are connected and can interact in an integrated way. These devices and their “language” are the focus of the **IoT&IT** master’s degree program.

The **IoT&IT** program will provide a strong academic and technical education to students who are interested in pursuing research and career aspirations in IoT digital technologies. The program will provide a comprehensive exploration of IoT technologies with a focus on building physical and technical resources through existing network framework.

The proposed **IoT&IT** program addresses the specific strategic plan to develop new and innovative programs found in both the USM and BSU strategic plans.<sup>5</sup>

b) *Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education*

*US News & World Report* has ranked BSU #25 on the list of the nation’s outstanding HBCUs.<sup>6</sup> Additionally, our high-impact and cross-curricular Course-based Undergraduate Research Experiences (CURES) enable entire classes to participate in research that attempts to answer questions of interest to the scientific community. The master's degree in IoT & Internet Technologies Program will accelerate our efforts and increase our department's capacity for a high-quality and sustainable research agenda. *US News & World Report* also reports that BSU is one of the top-ranked universities in social mobility. This program will give our graduates better job security and career options in academia and industry.

c) *The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs*

It has been recently recognized that HBIs lack support to build high-quality and unique educational programs across the United States. The state of Maryland recently reached a "\$577 million settlement to end a 15-year-old federal lawsuit that accused the state of providing inequitable resources to its four historically Black colleges and universities" (Bowie State University, Coppin State University, Morgan State University, and University of Eastern Shore).<sup>7</sup> In the ruling, the court did find that “HBCUs were not underfunded compared to traditionally white institutions, but that program duplication had perpetuated segregation.” The HBCUs in the state of Maryland are not alone in recognizing the inequities among HBCUs. In a recent analysis of state funding, "the state of Tennessee owes Tennessee State between \$150 million and \$544 million due to its failure to honor a land grant agreement."<sup>8</sup> The proposed **IoT&IT** master's degree program will be the only IoT master's degree program in the state of Maryland and the only IoT program at a HBCU awarding master's degrees.

1. *Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education.*

<sup>5</sup><https://www.usmd.edu/10yrplan/>

<sup>6</sup> <https://bowiestate.edu/about/news/2019/us-news-world-report-ranks-bowie-state-among-top-25-hbcus.php#:~:text=Bowie%20State%20also%20tied%20for,regional%20universities%20in%20the%20north.>

<sup>7</sup> <https://www.marylandmatters.org/2021/04/28/maryland-settles-hbcu-federal-lawsuit-for-577-million/>

<sup>8</sup> <https://www.arkrepublic.com/2021/05/27/tennessee-state-university-is-the-latest-hbcu-underfunded/>



The University System of Maryland's mission strives to improve the quality of life for Marylanders by "preparing graduates with the knowledge, skills, and integrity necessary to successful leaders and engaged citizens while providing knowledge-based programs and services that are responsive to the needs of the state and the nation." Approving the **IoT&IT** master's degree program at BSU aligns to the USM core value, "diversity and the creation of an environment that both celebrates and is enriched by the multiple perspectives, cultures, and traditions reflected in humankind."

**B. Quantifiable and Reliable Evidence and Documentation of Market Supply Demand in the Region and State:**

1. *Describe potential industry or industries, employment opportunities, and expected level of entry (ex: mid-level management) for graduates of the proposed program.*

Gartner estimated that there are 25 billion connected things such as Home IoT devices, Electric Cars, and Autonomous Cars are still growing in demand exponentially.<sup>9</sup> The largest professional network on the internet, LinkedIn, has ranked the top four most in-demand hard skills related to IoT products in 2020 to be blockchain, cloud computing, analytical reasoning, and artificial intelligence.<sup>10</sup> According to Gartner (2021), the IoT electronics and communications market will total \$21.3 billion in 2022, a 22 percent increase from a forecasted total of \$17.5 billion in 2021.<sup>11</sup> Additionally, Gartner predicts that the automotive Internet of Things market will reach \$82.8 billion by 2022, increasing \$20.0 billion in 2016.<sup>12</sup>

2. *Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.*

Dahlqvist, Patel, Rajko and Shulman (2019) reports the US Bureau of Labor Statistics projects an 11 percent growth of computer and information technology occupations from 2019 to 2029, much faster than the average for all occupations.<sup>13</sup> The further adoption of data science, IoT, cybersecurity, and cloud computing by large and small businesses and increasing use of IT services in healthcare settings are expected to increase demand for these workers, with Maryland and Virginia having the highest concentration of jobs, 26,310 and 17,760 jobs per the occupational employment data for May 2019.

According to Mordor Intelligence (2021), "the global IoT market grew to \$761.4 billion by 2020 and is expected to reach \$1.39 trillion by 2026." Additionally, "North America is expected to be a prominent market, owing to the growing role of IoT among the significant revenue-generating end-user industries of the region, driven by the deployment of connected cars, smart energy projects, home automation, and focus on smart manufacturing."

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<sup>9</sup> [https://www.gartner.com/imagesrv/books/iot/iotEbook\\_digital.pdf](https://www.gartner.com/imagesrv/books/iot/iotEbook_digital.pdf)

<sup>10</sup> <https://www.linkedin.com/business/learning/blog/learning-and-development/most-in-demand-skills-2020>

<sup>11</sup> <https://www.gartner.com/en/newsroom/press-releases/2021-06-30-gartner-global-government-iot-revenue-for-endpoint-electronics-and-communications-to-total-us-dollars-21-billion-in-2022>

<sup>12</sup> Ibid.

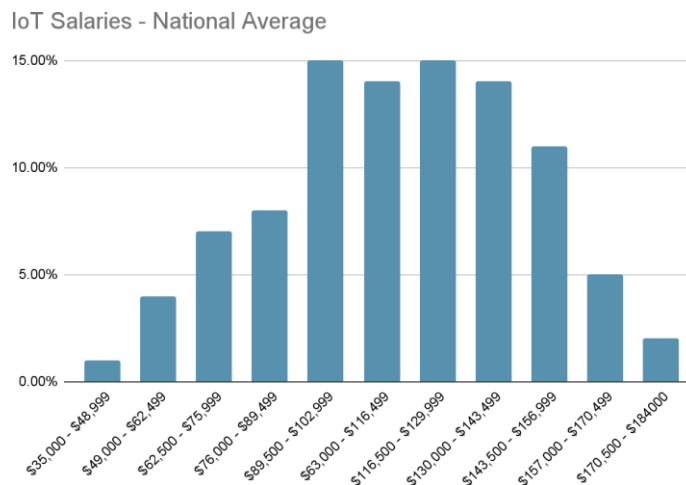
<sup>13</sup> <https://www.bls.gov/ooh/computer-and-information-technology/home.htm>

Internet of Things (IoT) Market - Growth Rate by Region (2021 - 2026)



3. Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.

According to EDUCBA, (an technology platform and educational forum) the steps in the career path to IoT jobs are user interface (UI)/user experience (UX) design development, devices and hardware, protection [security], network and structure, and data.<sup>14</sup> Current trends in IoT careers are wireless networking technologies, chip innovation, trusted operating systems and hardware, sensors, and more.<sup>15</sup> The career outlook in primary fields with expected vacancies are listed in the tables below:

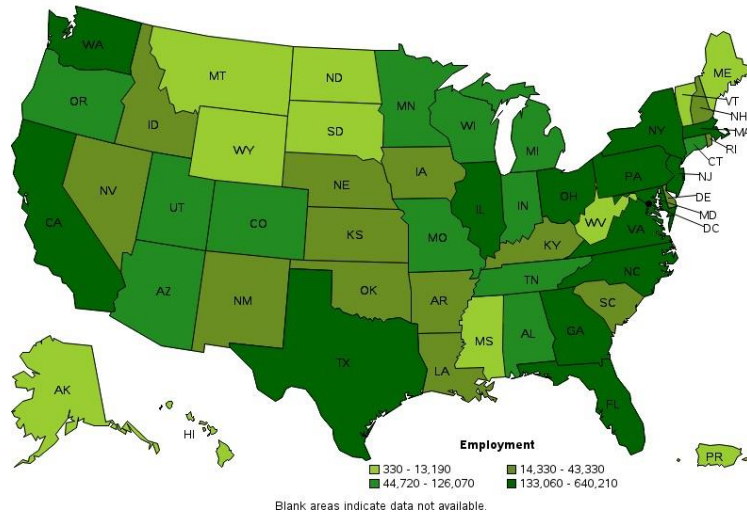


<sup>14</sup> <https://www.educba.com/iot-careers/>

<sup>15</sup> Ibid.

Note: According to the US Bureau of Labor Statistics, Occupational Employment and Wage Statistics, May 2020 (most recent data).<sup>16</sup>

Employment of computer and mathematical occupations, by state, May 2020



States with the highest concentration of jobs and location quotients in Computer Occupations, All Other:<sup>17</sup>

State	Employment	Employment per thousand jobs	Location quotient	Hourly mean wage	Annual mean wage
District of Columbia	18,170	26.45	10.15	\$ 58.88	\$ 122,460
Maryland	15,490	6.14	2.36	\$ 57.15	\$ 118,880
Utah	7,590	5.10	1.95	\$ 37.96	\$ 78,950
California	83,170	5.06	1.94	\$ 53.16	\$ 110,580
Colorado	11,170	4.33	1.66	\$ 53.30	\$ 110,870

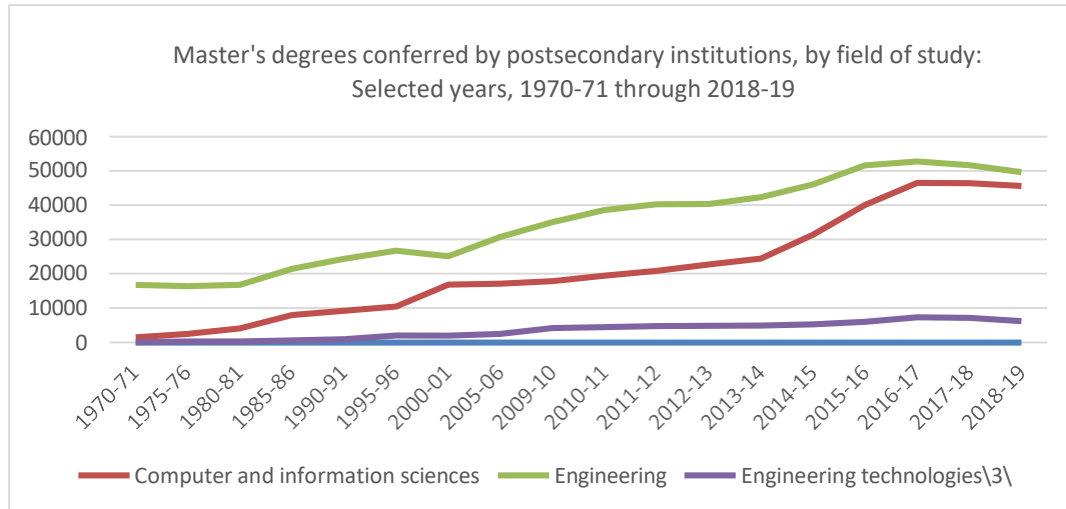
4. Provide data showing the current and projected supply of prospective graduates.

The **IoT&IT** Master of Science program is a cross-pollinated program to meet the educational and training needs to fill the vacancies found in IoT careers. Evidence of data showing the current and projected supply of prospective graduates is noted in the table below:

<sup>16</sup> <https://www.bls.gov/oes/current/oes150000.htm>

<sup>17</sup> <https://www.bls.gov/oes/current/oes151299.htm>

Over several decades graduates in the computer and information sciences and engineering fields have steadily climbed.



### C. Reasonableness of Program Duplication:

1. Identify similar programs in the State and/or the same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

According to an article posted in EdTech, Florida International University (FIU) offers a bachelor's and master's degree in IoT Management.<sup>18</sup> There are no IoT dedicated programs in the Delaware, Maryland, and Virginia regions. Morgan State University has an IoT Security Research Lab (The Center for Reverse Engineering and Assured Microelectronics).<sup>19</sup> However, the Morgan State University IoT Security Research Lab does not contain IoT or Internet Technologies curriculum. UMD School of Engineering has BS degree program in Embedded Systems and IoT program at Shady Grove. "The Embedded Systems major is a two-year, cohort-based program with a pre-set class schedule starting in the fall semester".<sup>20</sup> Towson University offers an introductory course on the Internet of Things through the Cisco Networking Academy but not a full program.<sup>21</sup> Bowie State University will be the first institution in the University System of Maryland and the state with this innovative and trending technology program.

2. Justify the proposed program.

Currently, Bowie State University provides the only Computer Technology program among the USM's colleges and universities, and the Department of Technology & Security at Bowie State University has strong research capabilities in data science, database, IoT, internet technologies, cloud computing, artificial intelligence, blockchain, and cybersecurity.

There are no **IoT or Internet Technologies** master's degree programs in any University of Maryland institution or other institutions in the District of Columbia, Maryland, and Virginia region. The **IoT&IT** program will cross-pollinate traditional discipline areas (e.g., AI, cybersecurity) to create a program to address emerging technologies in IoT and expand on the current undergraduate tracks offered in the Department of Technology and Security's Computer Technology program.

### D. Relevance to High-demand Programs at Historically Black Institutions (HBIs):

1. Discuss the Program's potential impact on implementing or maintaining high-demand programs at HBI's.

<sup>18</sup> <https://edtechmagazine.com/higher/article/2018/04/florida-international-university-leads-way-degree-iot-management>

<sup>19</sup> <https://technical.ly/baltimore/2017/10/13/morgan-state-opens-iot-security-research-lab/>

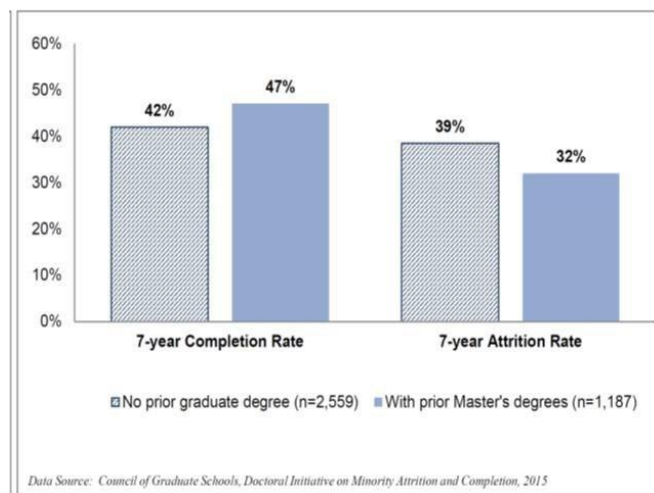
<sup>20</sup> B.S. in Embedded Systems and Internet of Things | The Universities at Shady Grove (umd.edu)

<sup>21</sup> <https://www.netacad.com/academy/3879>

Minority Serving Institutions (MSIs) serve students who are primarily non-traditional students and low-income students.<sup>22</sup> Out of the 106 MSIs, HBCUs comprise approximately 3 percent of America's colleges and universities yet produce about 25 percent of African American graduates with STEM degrees.<sup>23</sup> There are no dedicated **IoT or Internet Technologies** degrees at any MSI or HBCU institution, although there may be IoT content offered in courses across programs.

Though trend data from the US Census Bureau shows that those above the age of 25 who earn master's degrees have doubled since 2000, the National Center for Education Statistics demonstrates that the percentages of master's degrees conferred by historically Black institutions and to African Americans have decreased overall. We propose an accelerated master's program to capture all the underrepresented graduates, including the interested BSU undergraduate students. They otherwise would not pursue a master's degree after graduation due to financial burdens. The proposed accelerated program will also decrease financial barriers to transition to graduate school after a bachelor's degree, especially in technology.

A recent longitudinal study conducted from 1992 to 2012 by the Council of Graduate Studies reported underrepresented minority student (Hispanic and Black/African American) populations have poor attrition rates in STEM doctoral degrees suggests that the graduation rates significantly improved (Figure 2). The attrition rates were reduced for all underrepresented minority students if they had prior master's degree. This data provides a strong case for developing a rigorous IoT & Internet Technologies master's program to improve graduation rates and lower attrition rates of Black/African American students who continue to pursue doctoral degrees.

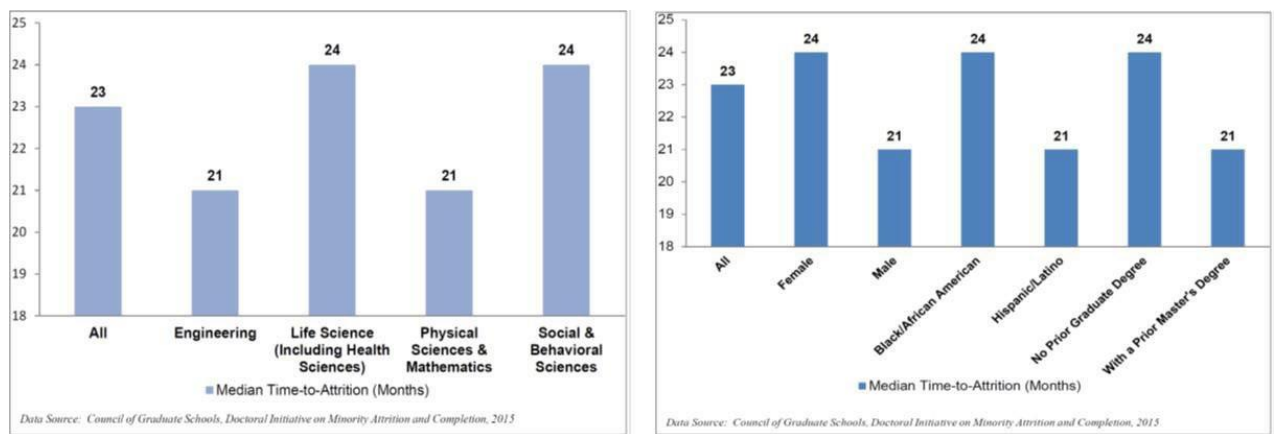


**Figure 2:** Seven-year doctoral completion and attrition rates of underrepresented minority students: Seven-year STEM doctoral degree completion and attrition rates among students with prior master's degree is compared. Grey color denotes a population with no prior graduate degrees, and blue represents a master's degree.

To further understand the attrition problem, researchers have looked at the time taken for attrition across all major doctoral programs and compared it to all minority populations (Fig. 3).

<sup>22</sup> <https://www.nap.edu/read/25257/chapter/6#80>

<sup>23</sup> <https://uncf.org/the-latest/6-reasons-hbcus-are-more-important-than-ever>



**Figure 3:** Median time to attrition of underrepresented minority students: (a) Median time (in months) to attrition of underrepresented minority students based on the field of study (b) Analysis of attrition of underrepresented minority students based on various characteristics.

## E. Relevance to the identity of Historically Black Institutions (HBIs):

### 1. Discuss the Program's potential impact on the uniqueness and institutional identities and missions of HBIs.

Currently, no HBCU offers a master's degree in **IoT & Internet Technologies**. Bowie State University's computer technology program offers a track in Internet Technologies. Howard University's Data Science and Cybersecurity Center has IoT topics included in computer science courses, but these are not focused areas of specialty where one can earn a degree.<sup>24</sup> The addition of this master's program will contribute to preparing underrepresented populations for employment in industry, academic, and governmental technology sectors; these are the fastest-growing areas of the American economy. With its proximity to the nation's capital and innumerable federal government contractors throughout the District of Columbia, Maryland, and Virginia, BSU is strategically positioned to increase diversity in the technology sector.

## F. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10):

### 1. Describe how the proposed program was established and describe the faculty who will oversee the program.

The existing Bachelor of Science degree in Computer Technology offers cybersecurity courses in the core and three tracks: Network Enterprise Infrastructure, Data Science and Database, and Internet Technologies. The **IoT&IT** program will cross-pollinate traditional discipline areas (e.g., AI, cybersecurity) to create a program to address emerging technologies in IoT, that expands the current undergraduate tracks in the Department of Technology & Security's Computer Technology program to the master's degree level. In 2019, the Department of Technology & Security's external advisory board identified the rise of the Internet of Things as a new and upcoming tech industry. Further, the external advisory board noted that the components of IoT, hardware, network framework, cybersecurity, data science, AI, ML, software, sensors, and data structures (blockchain), independently and combined build an IoT framework for the following industries, medical, transportation, telecommunication, and energy. The external advisory board concluded that the department should strongly consider a master's degree in IoT combined with internet technologies as a robust and aggressive advancement for students in the unique existing undergraduate program. Dr. Lethia Jackson, professor and chair of the Department of Technology & Security, will oversee the program implementation.

<sup>24</sup> <https://bowiestate.edu/academics/colleges/college-of-arts-and-sciences/departments/computer-science/graduate/masters-degree/required-courses.php> and <https://www.cybersecuritycenter.us/>

2. Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.

**Learning Objectives**

- Demonstrate how to produce, secure, operate, and troubleshoot IoT enterprise networks and learn how to implement mobile device security.
- Assemble machines in enterprise ventures with IoT infrastructure and examine IoT connectivity.
- Analyze satellite, 5G, and other wireless access performance metrics, frequencies, and characteristics and apply them to the IoT framework.
- Discover ways to install and configure operating systems using Command Line Interface (CLI).
- Distinguish appropriate Internet of Things technologies in various situations to lead to ideal outcomes and network infrastructures.
- Explore digital concepts, devices, and connectivity within the realm of the IoT to include networking, securing, deploying digital devices, and configuring and troubleshooting control systems.

**Learning Outcomes**

- Diagram and build IoT machines and ecosystems models with existing and emerging hardware and software entities.
- Reconstruct models to customize and maintain state-of-the-art IoT devices, Internet Technologies, and networks.
- Investigate and weigh data-driven decisions linking current IT infrastructure to emerging IoT infrastructure.
- Select and differentiate IoT applications, internet technologies, and protocols commonplace to the industry.
- Evaluate the legal and ethical implications of their work and the impact of decision-making in industry and the community.

**Modality**

The modality of the master's program is online. Bowie State University supports distance education and online learning through the Office of Academic Transformation, which leads the facilitation and evolution of the campus-wide online academic infrastructure and related innovation initiatives across teaching, research, and service.

3. Explain how the institution will:

- provide for assessment of student achievement of learning outcomes in the program
- document student achievement of learning outcomes in the program

The Department of Technology and Security procedures for evaluating courses, faculty, and student learning outcomes are affirmed through the Accreditation Board for Engineering and Technology (ABET)



accreditation achieved by the department's continuous improvement cycle:

The department assesses the effectiveness of its academic programs using a five-year program review process. The process consists of five stages: Plan, Implement, Evaluate, and Improve. The plan phase includes refining the strategies for assessing the program based upon improvement, recommendations, and learning outcomes. The implement phase administers direct and indirect assessments such as 1) analysis of program mission, goals, and objectives; 2) an assessment of the program according to internal and external data; 3) an assessment of the curriculum; 4) an assessment of student learning outcomes to include programmatic learning; and 5) an assessment of program resources and viability. The implement phase compiles, analyzes, and prepares recommendations to summarize key findings. The summary of key findings and data collection is the basis for the Improvement phase. Improvements are made to the program over the next four years. The program is evaluated in two additional ways: 1) graduates participate in a graduation survey and 2) The department's external advisory board reviews the learning outcomes and gives feedback.

*4. Provide a list of courses with title, semester credit hours, and course descriptions, along with a description of program requirements*

This Master of Science in IoT & Internet Technologies in the Department of Technology & Security will comprehensively prepare students for further advanced coursework and prepare them to be a part of the future STEM workforce. This program is also designed to develop soft skills such as innovative thinking, communication skills, ability to work with diverse teams, which is desirable both in academic and industrial settings. The curriculum of the IoT & Internet Technologies program consists of 12 courses, none of which have been through the university approval process thus far, include a 2-course thesis and a 2- course capstone. The thesis courses are divided into 2 separate courses that leads the students through a writing process to a completed thesis. Thesis part 1 (CTEC 720), students will apply relevant evidence-based research to content from earlier courses in the master's program and integrate technology infrastructure perspectives. The outcome of this course is a draft thesis in which student goes through a process of applying systematic technology theories and practices through the lens of innovation. Thesis Part II (CTEC 721) is a continuation of CTEC 720 that completes the final thesis writing process.

The capstone courses are divided into 2 separate courses that leads to development and implementation of a technology-based innovation. Capstone 1 (CTEC 711) is the software design which includes planning, requirements analysis and specification. Capstone 2 (CTEC 711) is a continuation of CTEC 711 which includes implementation, testing, verification and validation.

Students that applying to the master's program without the prerequisites are encouraged to take the prerequisite courses for full success in the program. The undergraduate prerequisite courses are CTE335, CTEC 120, CTEC 220, CTEC 230, CTEC302 and CTEC 345. If students applying for the master s program have 3 years of work experience, they can choose to take an exam that covers the prerequisite content and topics.

**CTEC 621 Edge Technologies Architecture(3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course teaches students how to utilize data from sensors and other remote devices. Students will institute essential IoT concepts, tools, and methodology using hands-on experience using the Intel Nervana AI Academy online environment and tool set stacks of the IoT kit and the Raspberry Pi. These experiences include building prototypes of devices at the edge of the Internet, typically referred to as The Internet of Things (IoT).

**CTEC 641 Internet Technologies Discovery ( 3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course identifies, collects, and preserves electronically stored information (ESI) and data from a range of IoT devices, such as smartwatches, medical devices, vehicles, doorbells, Amazon (Alexa, Dash, Alexa Echo Plus), home mesh WiFi systems, and cellular-based IoT devices. Students will have hands-on laboratory experience that focuses on digital evidence, data recovery, and logging methods to trace back cyber-attacks.



**CTEC 651 Internet of Things Digital Repository ( 3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course will build a scalable SQL Server machine that aggregates data items from separate databases into one centralized location.

**CTEC 661 Satellite and Mobile Communication (3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

In this course, the student will learn the fundamentals and techniques for designing and analyzing satellite communication systems and mobile and wireless communication to include 5G broadband cellular networks.

**CTEC 671 Smart Integrated Systems (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This class builds a blockchain machine that utilizes and addresses real-world problems and addresses core research topics in the smart industry.

**CTEC 681 – Fog and Edge Computing (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course enables the students to start building and creating IoT devices from scratch for home automation, building security, and assisted living use cases. This course touches all the necessary connections and components such as software, hardware, platform, protocols, edge computing, fog computing, and everything in between.

**CTEC 691 – Internet of Things Ecosystem and Analytics (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course describes the components of the IoT Ecosystem and investigates real-time solutions for effective decision making.

**CTEC 701 - Hardware-Oriented Security and Trust (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course investigates recent technology developments to design and evaluate secure and trustworthy hardware. Hardware security and trust techniques are required to ensure that chips remain secure and trustworthy during their entire lifecycle from design to manufacturing, deployment, service, and retirement. The following topics are covered in this course and their application to the Internet-of-Things (IoT): autonomous cars, smart homes, smart grid, factory automation, innovative infrastructure, and cloud computing.

**CTEC 711 Internet of Things Capstone I (3 credits)**

**Prerequisite Graduate Standing and Permission of Instructor**

Major team-based software design project to be undertaken in a student's final year of study; project planning, software requirements analysis, design, and specification. Written reports and oral presentations in a technical setting.

**CTEC 712 Internet of Things Capstone II (3 credits)**

**Prerequisite CTEC 711**

Continuation of CTEC 711. Computer system implementation, testing, verification and validation of results. Written reports and oral presentations in a technical setting.

**CTEC 720 Master's Thesis Research I (3 credits)**

**Co-Requisite CTEC 711**

In this course, students will apply relevant evidence-based research to content from earlier courses in the master's program and integrate technology infrastructure perspectives. Students are expected to develop scholar-practitioner competencies for applying systematic technology theories and practices through the

lens of innovation and consider topics such as systems integration and IoT infrastructure as they complete the stages of the thesis writing process.

### **CTEC 721 Master's Thesis Research II (3 credits)**

#### **Co-Requisite – CTEC 711 and Prerequisite CTEC 720**

This course is a continuation of CTEC 720. In this course, students will continue to apply relevant evidence-based research to content from earlier courses in the master's program and integrate technology infrastructure perspectives. Students are expected to further develop scholar-practitioner competencies for applying systematic technology theories and practices through the lens of innovation and consider topics such as systems integration and IoT infrastructure as they complete the final stages of the thesis writing process.

5. *Discuss how general education requirements will be met, if applicable. NA*
6. *Identify any specialized accreditation or graduate certification requirements for this program and its students. NA*
7. *If contracting with another institution or non-collegiate organization, provide a copy of the written contract. NA*
8. *Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies.*

Communication at the program and institutional level is accomplished through publication on the Bowie State University's website, brochures, and graduate catalogs to include the Department of Technology and Security's website. The university will provide identical resources to students in the proposed program that other programs at Bowie State University are provided to ensure that clear, complete, and timely information is available. With the university's approvals the first set of courses will be implemented fall 2022. Information regarding curriculum, courses, degree requirements, including suggested sequence pathways, programmatic brochures and handbooks, admission information, and costs and payment policies are available on the university's main website located at <https://www.bowiestate.edu/admissions-and-aid/>. The university's graduate academic catalog can be accessed at <https://bowiestate.edu/academics/catalogs.php>. There are several links as it relates to student interactions: 1) Campus Life - <https://www.bowiestate.edu/campus-life/>, 2)- Prospective students - <https://www.bowiestate.edu/admissions-and-aid/>, 3) Parents and Family - <https://www.bowiestate.edu/admissions-and-aid/information-for-parents-and-families.php>, 4) Student Services - <https://www.bowiestate.edu/campus-life/student-services/>, 5) Academics - <https://www.bowiestate.edu/academics/>, 6) Online Learning - <https://bowiestate.edu/about/administration-and-governance/division-of-academic-affairs/academic-computing-and-online-course-support/online-learning-forms.php> and 7) Support Services - <https://www.bowiestate.edu/academics/support-services/>. A syllabus for each course is provided to communicate clear information on how students are expected to achieve the course-level learning outcomes.

The program will work with the Dean of the graduate school to admit the students. The department will have a graduate committee to offer suggestions to the graduate school on admittance. Each student admitted will be assigned an advisor and given a program of study as a checklist to know their progress and degree to completion. The advisor will maintain a 1 faculty per 10 graduate student ratios. The tuition and fees as of fall/spring 2021-22 is \$561.57 per credit. Students can work with the financial office at Bowie State University for tuition assistance.

9. *Provide assurance and appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the available services.*

The University Relations and Marketing Office manages the Bowie State University website. Essential information is updated consistently in collaboration with all relevant departments, including Academic Affairs, Learning Support, Financial Aid, Registration & Records, Student Development, and Enrollment Services. This process ensures the available materials are clear and accurate and contain pertinent information regarding all program offerings and services available. Upon confirmation of the proposed degree, the Office of University Relations and Marketing would activate an integrated marketing communications plan, working closely with Admissions and the Graduate school. The department will have a graduate committee to offer suggestions to the graduate school on admittance.

**Adequacy of Articulation:**

1. *If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.*

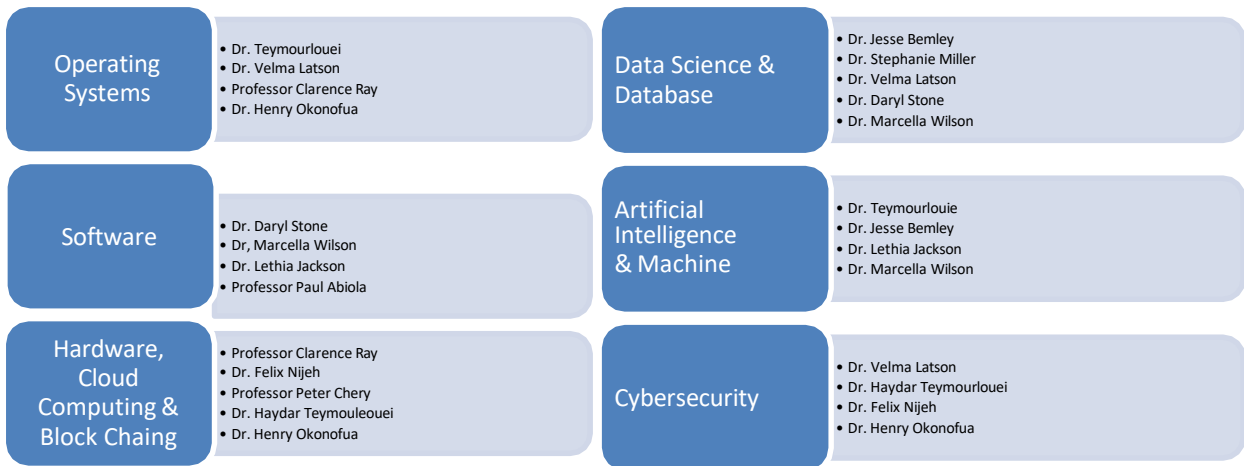
**IoT&IT** is a program that crosses several academic domains; Bowie State University has brokered several articulation agreements with community colleges in the state of Maryland. Bowie State University is committed to serving our non-traditional students and transfer students and has several programs and initiatives to maximize student success. We are confident that the existing articulation agreement with the community colleges and other institutions in Maryland will support undergraduate enrollment in the Department of Technology & Security. The undergraduate program will be a feeder to the graduate program.

**G. Adequacy of Faculty Resources** (as outlined in COMAR 13B.02.03.11):

1. *Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct), and the course(s) each faculty member will teach in the proposed program.*

The Department of Technology and Security at BSU is home to highly experienced and specialized faculty in operating systems, software, hardware, data science, database, cybersecurity, artificial intelligence, machine learning, blockchain, and cloud computing.

The expertise of our research faculties can be aligned into the six major cross-pollinating disciplines as shown below:



We have qualified faculty in the Department of Technology & Security listed in the table below that have indicated their interest in participating in the IoT & Internet Technologies program. In addition to the faculty listing below, the Department of Technology & Security is committed to supporting each course with a dedicated laboratory coordinator, in addition to hiring adjunct faculty, as needed. Additional staff includes research coordinators, laboratory technicians, and laboratory assistants. Currently interested full-time tenured, tenure-track faculty and adjuncts are listed below:

<b>Faculty</b>	<b>Appointment Type/Rank</b>	<b>Area of Specialization</b>	<b>Degree</b>	<b>Courses that can be taught</b>	<b>Status</b>
Dr. Jesse Bemley	Lecturer	Programming, AI, Machine Learning, Architecture, Data Science, IoT	Ph.D. in Public Administration	CTEC 621 CTEC 651 CTEC 671 CTEC 691 CTEC 720 CTEC 721	Full- time
Dr. Lethia Jackson	Professor/Tenured	Programming, Data Science, IoT, AI, Blockchain and Machine Learning	D.Sc. in Computer Science	CTEC 621 CTEC 671 CTEC 691 CTEC 701 CTEC 711 CTEC 711 CTEC 720 CTEC 721	Full- Time
Dr. Velma Latson	Assistant Professor/Tenure Track	Network Security, IoT, Cybersecurity	Doctor of Management	CTEC 621 CTEC 651 CTEC 691 CTEC 701 CTEC 711 CTEC 711 CTEC 720 CTEC 721	Full- Time
Dr. Stephanie Miller	Adjunct	Data Science	Pd.D. in Urban Education Professional Certificate, Data Science	CTEC 681 CTEC 711 CTEC 712	Adjunct

Dr. Felix Njeh	Adjunct	Programming, Network Security, Cloud Computing, Cybersecurity, Architecture, Wireless, IoT	D.Sc. in Computer Science	CTEC 651 CTEC 661 CTEC 671 CTEC 681 CTEC 701 CTEC 711 CTEC 712 CTEC 720 CTEC 721	Adjunct
Dr. Henry Okonofua	Adjunct	Cybersecurity, Network Security, Wireless	D.Sc. in Cybersecurity	CTEC 651 CTEC 661 CTEC 681 CTEC 701 CTEC 711 CTEC 712 CTEC 720 CTEC 721	Adjunct
Dr. Daryl Stone	Associate Professor/Tenured	Programming, Database, IoT	D.Sc. in Computer Science	CTEC 621 CTEC 651 CTEC 701 CTEC 711 CTEC 712 CTEC 720 CTEC 721	Full- Time
Dr. Haydar Teymourlouei	Assistant Professor/Tenured	Programming, Network Security, Cloud Computing, Cybersecurity, Blockchain	Ph.D. in Cybersecurity and Information Assurance	CTEC 641 CTEC 661 CTEC 671 CTEC	Full- Time

		Architecture, Wireless		681	
Dr. Marcella Wilson	Instructor/Tenure Track	Programming, IoT, Database, Blockchain	Ph.D. in Computer Science	CTEC 621 CTEC 651 CTEC 671 CTEC 701 CTEC 711 CTEC 712 CTEC 720 CTEC 721	Full- Time

2. *Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidence-based best practices, including training in:*

a) *Pedagogy that meets the needs of the students*

Internally, faculty have access to the Center for Excellence in Teaching and Learning (CETL), funded through the Access to Success grant program of the Maryland Higher Education Commission, that supports the professional development of the teaching community at Bowie State University. In addition to two annual institutes, the center provides workshops and seminars that focus on theories of education, application of successful teaching techniques used at BSU and other universities, basic teaching strategies, distance education, and the use of new technologies.

In addition to CETL, the university holds mandatory workshops twice a year. Departmental retreats also are held twice a year. These workshops contribute to professional development.

Externally, faculty regularly attends conferences, symposia, and other professional development activities funded by the department, university, and grants.

b) *The learning management system*

BSU utilizes the Blackboard Learning Management System for online instruction. Academic Computing ensures CETL, Academic Computing, and Academic Affairs partner to bring distance education training to faculty through the learning online LOTTO training sessions. LOTTO is designed to assist faculty with using appropriate tools on the University's Blackboard Learning Management System.

c) *Evidenced-based best practices for distance education if distance education is offered.*

BSU's Office of Academic Computing and Online Course Support helps faculty ensure quality matters standards are adhered to in supporting instruction and learning through various delivery methods. A shortlist of academic computing, and online course support includes, but is not limited to, training videos, workshops, walk-in training, and help desk support for students.

#### H. **Adequacy of Library Resources** (as outlined in COMAR 13B.02.03.12):

*Describe the library resources available or the measures to ensure resources are adequate to support the proposed program.*

The Thurgood Marshall Library of Bowie State University has several holdings, including top databases for Technology, Security, Computer Science, and Mathematics, to support the **IoT&IT** master's degree program. Select databases are described below:

- **Access Science:** A searchable, electronic version of the McGraw-Hill Encyclopedia of Science and

- Technology. Includes a science dictionary, news articles, research updates, biographies, information about data, tables, and video, a question-and-answer archive, links to websites, and illustrations.
- **ACM Digital Library:** Online access to the full text of all ACM publications, including journals, magazines, conference proceedings, newsletters, websites, and multimedia files; the complete archive of all ACM publications; all ACM related publications including, including approximately 12 journals, proceedings, and bulletins; and ACM Guide to Computing Literature, ACM's bibliographic database and abstracting & indexing service and more.
  - **Computer Science, Gale ONFILE:** Provides access to leading business and technical publications in the computer, telecommunications, and electronics industries. The database includes more than 600 journals and periodicals, providing information on computer-related product introductions, news, and reviews in hardware, software, electronics, engineering, communications, and the application of technology.
  - **IEEE Xplore Digital Library:** A powerful resource for discovery and access to scientific and technical content published by the IEEE (Institute of Electrical and Electronics Engineers) and its publishing partners.
  - **JSTOR:** A digital library of more than 1,500 academic journals, books, and primary sources in humanities, sciences, and social sciences.
  - **Library, Information Science & Technology Abstracts:** Library, Information Science & Technology Abstract (LISTA) indexes more than 600 periodicals, plus books, research reports, and proceedings. Subject coverage includes librarianship, classification, cataloging, bibliometrics, online information retrieval, information management, and more. Coverage in the database extends back as far as the mid-1960s.
  - **EBSCO:** Offers a rich selection of eBook titles covering a broad range of general reference subjects. Topics include biography, history, careers, cooking, literature, genealogy, health, parenting, personal finance, politics, architecture, science, current events, social-emotional health, sports, and travel.
  - **Military & Government Collection:** Provides cover-to-cover full text, indexing, and abstracts for hundreds of journals and periodicals, and US government documents. Many full-text titles are available in searchable PDF or scanned-in-color. Nearly 300 full-text journals and periodicals, and indexing and abstracts for 430 journals and periodicals
  - **SAGE Journals:** SAGE is a global academic publisher of books, journals, and a growing suite of library products and services.
  - **ScienceDirect:** The leading database for journal articles and ebooks in science, engineering, and medical literature. Extensive coverage of the physical and biological sciences, significant numbers of journals in the social sciences, and some journals in the humanities.

**K. Adequacy of Physical Facilities, Infrastructure, and Instructional Equipment** (as outlined in COMAR 13B.02.03.13):

*1. Provide an assurance that physical facilities, infrastructure, and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences.*

In 2017, the Department of Technology & Security installed a separate Comcast line, that contains isolated sandbox laboratory spaces used for teaching technology courses, to support the facility, flexible classrooms, and active learning classrooms. There are three sandbox laboratory instructional classrooms with computer systems that support removable hard drives and connections to the Comcast line. Department of Technology & Security also has three research laboratories: 1) Data Center Lab, 2) Cloud Architecture Lab, and 3) I<sup>3</sup> (Innovation, Ideation, and Internet of Things) Lab.

BSU has a partnership agreement with Cisco Academy through the Red River Technology LLC initiative that provides educators and students comprehensive resources for building and configuring edge technology devices. Edge technology equipment is being deployed in the Department of Technology and Security instructional and Data Center research labs to prepare students to pursue careers in IoT, cloud architecture, software development, and DevOps, software development, and delivery system.

2. Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:

- a) An institutional electronic mailing system, and
- b) A learning management system that provides the necessary technological support for distance education

To accommodate students enrolled at BSU, all students are provided with a bowiestate.edu email account. This one email account is used as a single-signed-on (SSO) authentication for all BSU students' resources (e.g., Microsoft Office 365 tools) and the BSU learning management system Blackboard. The Division of Information Technology provides students with support for:

- Blackboard Learn
- Bulldog Connection (online registration system)
- Email (Outlook)
- Loaner Laptop or similar device
- Microsoft Office 365
- Password resets (IT Help Desk)
- WiFi and WiFi hotspots
- Online tutoring (SmarThinking)

**L. Adequacy of Financial Resources with Documentation** (as outlined in COMAR 13B.02.03.14):

1. Complete **Table 1: Resources and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also, give a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.

The table below explains the resource rationale for the master's program. Year 1 estimates 10 students with a growth of 15% each subsequent year. The credit hour rate is based on the tuition and fees published by the University. Resource category #2 is an estimate of the revenue as projected by the number of anticipated students in participation. Students are expected to take up to 24 credit hours per academic year. This is based on a 8 week semester in which the student register for two courses (6 credits) per 8 weeks and four courses ( 12 credits) per semester ( 8 week 1 and 8 week 2).

TABLE 1: RESOURCES					
Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Reallocated Funds <sup>1</sup>	0	0	0	0	0
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$134,776.8 0	\$166,561 .92	\$200,172	\$235,438 .08	\$273,041 .28
a. #F.T Students	10	12	14	16	18
b. Annual Tuition/Fee Rate <sup>3</sup>	\$13, 477.68	\$13,881. 60	\$18,000	\$14,715. 12	\$15,168. 96
c. Annual Full Time Revenue (a x b)	\$67,388,40	\$83,280 .96	\$100,086	\$117,719 .04	\$136,520 .64
d. # Part Time Students	0	0	0	0	0
e. Credit Hour Rate <sup>4</sup>	\$561.57	\$578.40	\$595.75	\$613.13	\$632.04
f. Annual Credit Hours	24	24	24	24	24
g. Total Part Time Revenue (d x e x f)	0	0	0	0	0



3. Grants, Contracts, & Other External Sources <sup>5</sup>	0	0	0	0	0
4. Other Sources	0	0	0	0	0
TOTAL (Add 1 - 4)	\$134,776.80	\$166,561.92	\$200,172	\$235,438.08	\$273,041.28

Note:1. Whenever reallocated funds are included among the resources available to new programs, the following information must be provided in a footnote: origin(s) of reallocated funds, the impact of the reallocation on the existing academic program (s), and how the reallocation is consistent with the institution's strategic plan.

<sup>2</sup> This value represents 100% of the projected total Tuition & Fee revenues for Full Time & Part Time students

<sup>3</sup> Tuition Rate is based on the FY 2021 Proposed Tuition & Rate Schedule with a 3% increase in the subsequent years.

<sup>4</sup> Credit Hour Rate is based on the FY 2021 Proposed Tuition & Rate Schedule with a 2% increase next year.

<sup>5</sup> Whenever external funds are included among the resources, the following information must be provided in a footnote: source of the funding and alternative methods of funding the program after the cessation of external financing. Title III Funding is anticipated to begin the program and is expected through subsequent years.

2. Complete **Table 2: Program Expenditures and Narrative Rationale**. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also, provide a narrative rationale for each expenditure category.

Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses (b + c below)	\$804,449.04	\$820,568.33	\$836,979.98	\$853,719.57	\$870,793.96
a. # FTE	12	12	12	12	12
b. Total Salary <sup>6</sup>	\$744,888	\$759,785.76	\$774,981.47	\$790,481.09	\$806,290.71
c. Total Benefits <sup>7</sup>	\$59,591.04	\$60,782.86	\$61,998.51	\$63,238.48	\$64,503.25
2. Total Administrative Staff Expenses(b + c below)	\$60,480	\$62,013.60	\$62,923.39	\$64,181.85	\$65,465.49
a. overload/adjunct pay <sup>8</sup>	\$39,000	\$39,901	\$40,575	\$41,387	\$42,214.85
b. Total Salary <sup>9</sup>	\$56,000	\$57,420	\$58,262.40	\$59,427.64	\$60,616.20
c. Total Benefits <sup>10</sup>	\$4,480	\$4,593.60	\$4,660.99	\$4,754.21	\$4,849.26
3. Total Support Staff Expenses (b + c below)	\$91,800	\$93,636	\$95,508.72	\$97,418.89	\$99,367.26
a. # FTE	1	1	1	1	1
b. Total Salary <sup>11</sup>	\$85,000	\$86,700	\$88,434	\$90,202.68	\$92,006.73
c. Total Benefits <sup>12</sup>	\$6,800	\$6,936	\$7,074.72	\$7,216.21	\$7,360.53
4. Equipment/Refresh 100 computers with monitors	\$271,308			\$271,308	

5. Library	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	0	0	0	0	0
<b>TOTAL (Add 1 - 7)</b>	<b>\$1,180, 237</b>	<b>\$826029.56</b>	<b>\$945,478.37</b>	<b>\$1,235,596.40</b>	<b>\$983,474.30</b>

<sup>6</sup> Average Course Overload Salary for Assistant Professors in DTS for FY 2021 with a 2% increase in subsequent years.

<sup>7</sup> Fringe Benefits for Assistant Professors in DTS for FY 2021 is 8% of Salary with a 1% increase in subsequent years. (Notes: There are no benefits associated with course overload salaries during the semester. In the summer months, the benefits rate associated with course overload is 8%.)

<sup>8</sup> Estimated overload and adjunct pay at \$6,500 \* 12 courses in the master's program

<sup>9</sup> Administrative Assistant II in FY 2021 with a 2% increase in subsequent years.

<sup>10</sup> Fringe Benefits for Administrative Assistant II in FY 2021 is 8% of Salary

<sup>11</sup> Average Salary for System Administrator in FY 2021 with 2% increase in following years

<sup>12</sup> Fringe Benefits for Lab Technician in FY 2021 is 8% of Salary.

**M. Adequacy of Provisions for Evaluation of Program** (as outlined in COMAR 13B.02.03.15):

*1. Discuss procedures for evaluating courses, faculty, and student learning outcomes.*

Bowie State University's Self-Study Design Plan for Middle States Commission on Higher Education, Standard V: Educational Effectiveness Assessment outlines the instruments used by the university to evaluate courses, faculty, and student learning outcomes:<sup>25</sup>

- BSU Annual Assessment Reports
- BSU Academic Department Curriculum Committee Actions
- BSU University Curriculum Committee Actions
- BSU General Education Committee Actions
- BSU Retention and Graduation Rates (first-time freshmen, transfer students, and new graduate students) by program
- Student Achievement Measure Reports
- National Student Clearinghouse Reports
- EMSI Reports
- BSU Graduating Student Surveys
- BSU First Destination Survey
- MHEC Graduating Student Surveys
- Specialized Accreditation Reports

The Department of Technology and Security utilizes a continuous improvement cycle to achieve improvements in learning and promote effectiveness, efficiency, and quality student learning. The continuous improvement process has been affirmed through the Accreditation Board for Engineering and Technology (ABET) accreditation achieved by the department's continuous improvement cycle:



All seniors complete the final core capstone course, CTEC 450, by demonstrating critical thinking, problem-solving, research skills, mastery of content and teamwork to solve a cumulative problem using experiential learning.

**N. Consistency with the State's Minority Achievement Goals** (as outlined in COMAR 13B.02.03.05):

1. *Discuss how the proposed program addresses minority student access & success and the institution's cultural diversity goals and initiatives.*

Bowie State University has a long-standing commitment to diversity and celebrates educational diversity in all its forms. Bowie State University primarily serves underrepresented minorities. The prevailing belief at Bowie State University is that its educational environment is enriched by the diversity of individuals, groups, and cultures that come together in a spirit of learning. As the university aspires to even greater racial diversity, it fully embraces the global definition of diversity that acknowledges and recognizes differences and advances knowledge about race, gender, ethnicity, national origin, political persuasion, culture, sexual orientation, religion, age, and disability. The university creates positive interactions and cultural awareness among students, faculty, and staff through infusing global diversity awareness in the curriculum, expanding co-curricular programming that promotes diversity awareness, and maintaining a campus climate that respects and values diversity. Additionally, civic engagement, visionary leadership, and global citizenship are foremost priorities for all faculty, staff, and students.

**O. Relationship to Low Productivity Programs Identified by the Commission:**

1. *If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources, and general operating expenses) may be redistributed to this program.*

N/A

**P. Adequacy of Distance Education Programs** (as outlined in COMAR 13B.02.03.22):

1. *Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.*  
 Bowie State University supports distance education and online learning through the Office of Academic<sub>25</sub>

Transformation and Academic Computing & Online Course Support which leads the facilitation and evolution of the campus-wide online academic infrastructure and related innovation initiatives across teaching, research, and service. Bowie State uses the Blackboard Learning Management System to support the University's online programs. Department of Technology and Security faculty have achieved certification of completion for all professional development provided through the Office of Academic Transformation. There is a designated faculty as the DTS Blackboard Coordinator. Faculty received \$20,000 in grant funding for NCAT course development of MOOC collaboration with Rice University from the USM Center of Academic Innovation partnership with Ithaka S&R and the Gates foundation.

2. *Provide assurance and appropriate evidence that the institution complies with the C-RAC guidelines, mainly related to the proposed program.*

In 2015, *US News and World Report* published an article that stated that a growing number of universities currently offer accelerated master's degree programs.<sup>26</sup> We are therefore proposing to provide an accelerated master's program. Many minority students are Pell Grant eligible as well as first-generation college students; therefore, we must develop a unique, rigorous, affordable, and holistic master's program such as IoT & Internet Technologies encompassing all the aspects of internet technology to prepare for the IoT workforce for academia. The curriculum is designed to prepare students from cybersecurity to cloud computing to data sciences to databases. This program provides an affordable opportunity to students in the competitive and expensive higher education landscape of computer technology degree programs. An accelerated master's program also reduces costs by reducing the time spent working towards the degree.

The accelerated IoT & Internet Technologies proposal program is geared towards the BSU Computer Technology undergraduate students. They will require submission of the general admission requirements as follows: biographical information about the candidate, an updated résumé, a personal statement, unofficial transcripts from each institution where course credit has been earned, and at least two letters of recommendation, with a required recommendation from a faculty member who can speak to the candidate's abilities.

All students will receive clear, complete, and timely information on course progression, with ample opportunity for advisement and career mentorship through frequent faculty advisor interactions. Students will be trained on all aspects of technological competence, including learning to give scientific presentations, design experiments, conduct research, and how to write grants. All students are expected to present their research during the Graduate Symposium. All BSU students are supported by the Office of Academic Computing, the Advisement Center, the Office of Financial Aid, the Provost's Office for Academic Affairs, and the Office of Research and Sponsored Programs. Overall, IoT & Internet Technologies Program will be administered under the oversight of the BSU graduate program.

Below is the proposed course progression for core courses and graduate electives. Core and graduate descriptions are included in Appendix D.

**Courses:**

- CTEC 621 Edge Technologies Architecture (3 credits)
- CTEC 641 Internet Technologies Discovery (3 credits)
- CTEC 651 IoT Digital Repository (3 credits)
- CTEC 661 Satellite and Mobile Communication (3 credits)
- CTEC 671 Smart Integrated Systems (3 credits)
- CTEC 681 Fog and Edge Computing (3 credits)
- CTEC 691 IoT Ecosystem and Analytics (3 credits)
- CTEC 701 Hardware-Oriented Security and Trust
- CTEC 711 IoT Capstone I (3 credits)
- CTEC 712 IoT Capstone II (3 credits)

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<sup>26</sup> <https://www.usnews.com/education/online-education>

CTEC 720 Master's Thesis Research I (3 credits)  
 CTEC 721 Master's Thesis Research II (3 credits)

Proposed Course Progression for the Program:

Semester	Course	Course
Fall 2022 8-week 1	CTEC 621 Edge Technologies Architecture	CTEC 641 Internet Technologies Discovery
Fall 2022 8-week 2	CTEC 651 IoT Digital Repository	CTEC 661 Satellite and Mobile Communication (Request for overload credits written to the Registrar)
Spring 2023 8-week 1	CTEC 671 Smart Integrated Systems	CTEC 681 – Fog and Edge Computing
Spring 2023 8-week 2	CTEC 691 – IoT Ecosystem and Analytics	CTEC 701 - Hardware-Oriented Security and Trust (Request for overload credits written to the Registrar)
Summer Session 1	CTEC 711 IoT Capstone I	CTEC 720 Master's Thesis Research I
Summer Session 2	CTEC 711 IoT Capstone II	CTEC 721 Master's Thesis Research II

<b>Career</b>	<b>ID</b>	<b>Acad Prog</b>	<b>Acad Plan</b>	<b>Sub-Plan</b>	<b>ChkoutStat</b>
UGRD	2144330	ASUG	ARTS-BA	ART-BA	AW
UGRD	2163148	ASUG	ARTS-BA	MUTE-BA	AW
UGRD	2151394	ASUG	ARTS-BA	MUTE-BA	AW
UGRD	2151413	ASUG	BIOL-BS		AW
UGRD	2165214	ASUG	BIOL-BS		AW
UGRD	2175962	ASUG	BIOL-BS		AW
UGRD	2162554	ASUG	BIOL-BS		AW
UGRD	2173064	ASUG	BIOL-BS		AW
UGRD	2128287	ASUG	BIOL-BS		AW
UGRD	2155766	ASUG	BIOL-BS		AW
UGRD	2136436	ASUG	BIOL-BS		AW
UGRD	2149588	ASUG	BIOL-BS		AW
UGRD	2163030	ASUG	BIOL-BS		AW
UGRD	2183941	ASUG	BIOL-BS		AW
UGRD	2153891	ASUG	BIOL-BS		AW
UGRD	2151103	ASUG	BIOL-BS		AW
UGRD	2158599	ASUG	BIOL-BS		AW
UGRD	2151328	ASUG	BIOL-BS		AW
UGRD	2154343	ASUG	BIOL-BS		AW
UGRD	2157918	ASUG	BIOL-BS		AW
UGRD	2156020	ASUG	BIOL-BS		AW
UGRD	2158192	ASUG	BIOL-BS		AW
UGRD	2177482	ASUG	BIOL-BS		AW
UGRD	2183080	ASUG	BIOL-BS		AW
UGRD	2199388	ASUG	BIOL-BS		AW
UGRD	2155954	ASUG	BIOL-BS		AW
UGRD	2158096	ASUG	BIOL-BS		AW
UGRD	2195860	ASUG	BIOL-BS		AW
UGRD	2168348	ASUG	BIOL-BS		AW
UGRD	2154708	ASUG	BIOL-BS		AW
UGRD	2166950	ASUG	BIOL-BS		AW
UGRD	2156523	ASUG	BIOL-BS		AW
UGRD	2146599	ASUG	BIOL-BS		AW
UGRD	2141007	ASUG	BIOL-BS		AW
UGRD	2126066	ASUG	BIOL-BS		AW
UGRD	2139095	ASUG	BIOL-BS		AW
UGRD	2179531	ASUG	BIOL-BS		AW
UGRD	2142068	ASUG	BIOL-BS		AW
UGRD	2144877	ASUG	BIOL-BS		AW
UGRD	2131717	ASUG	BIOL-BS		AW
UGRD	2168357	ASUG	BIOL-BS		AW
UGRD	2157916	ASUG	BIOL-BS		AW
UGRD	2157052	ASUG	BIOL-BS		AW
UGRD	2150137	ASUG	BIOL-BS		AW
UGRD	2158564	ASUG	BIOL-BS		AW
UGRD	2152165	ASUG	COMM-BS	BJRN-BS	AW

UGRD	2186155	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2158665	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2202906	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2139738	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2152756	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2181232	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2148399	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2203772	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2203746	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2166408	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2128197	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2132596	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2148736	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2183764	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2206526	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2172678	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2166510	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2011392	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2112243	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2145868	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2202867	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2219344	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2135392	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2180906	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2136373	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2207616	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2191468	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2191970	ASUG	COMM-BS	BJRN-BS	AW
UGRD	2139883	ASUG	COMM-BS	EMED-BS	AW
UGRD	2147622	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2149730	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2205118	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2184631	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2194586	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2140246	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2151916	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2127876	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2150368	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2218370	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2147644	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2153105	ASUG	COMM-BS	PBRL-BS	AW
UGRD	2152455	ASUG	COSC-BS		AW
UGRD	2196188	ASUG	COSC-BS		AW
UGRD	2168287	ASUG	COSC-BS		AW
UGRD	2158971	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2160075	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2154712	ASUG	CTEC-BS	CNSA-BS	AW

UGRD	2158311	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2131891	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2116045	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2197749	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2183261	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2204481	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2171101	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2162245	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2136203	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2172695	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2122409	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2185477	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2181729	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2188481	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2131241	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2078477	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2202055	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2152681	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2032893	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2187044	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2179959	ASUG	CTEC-BS	CNSA-BS	AW
UGRD	2156351	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2177031	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2152706	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2153331	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2181321	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2127143	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2157358	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2168784	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2148323	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2123140	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2177909	ASUG	CTEC-BS	DDAD-BS	AW
UGRD	2181303	ASUG	CTEC-BS	MMAP-BS	AW
UGRD	2131421	ASUG	CTEC-BS	MMAP-BS	AW
UGRD	2144111	ASUG	CTEC-BS	MMAP-BS	AW
UGRD	2153436	ASUG	CTEC-BS	NESE-BS	AW
UGRD	2151697	ASUG	CTEC-BS	NESE-BS	AW
UGRD	2165320	ASUG	CTEC-BS	NESE-BS	AW
UGRD	2154850	ASUG	ENGL-BA	LGLT-BA	AW
UGRD	2131974	ASUG	GOVT-BA	GOGN-BA	AW
UGRD	2148422	ASUG	GOVT-BS	GOGN-BS	AW
UGRD	2159517	ASUG	GOVT-BS	GOGN-BS	AW
UGRD	2151422	ASUG	GOVT-BS	GOGN-BS	AW
UGRD	2177815	ASUG	GOVT-BS	GOGN-BS	AW
UGRD	2185575	ASUG	HIST-BS	HIGN-BS	AW
UGRD	2180683	ASUG	VCDMA-BS	ADVD-BS	AW
UGRD	2004247	ASUG	VCDMA-BS	ADVD-BS	AW



UGRD	2144860	ASUG	VCDMA-BS	DCTM-BS	AW
UGRD	2150767	ASUG	VCDMA-BS	DCTM-BS	AW
UGRD	2156019	ASUG	VCDMA-BS	DCTM-BS	AW
UGRD	2141654	ASUG	VCDMA-BS	DGMA-BS	AW
UGRD	2148391	ASUG	VCDMA-BS	DGMA-BS	AW
UGRD	2146937	ASUG	VCDMA-BS	FSDE-BS	AW

## Fall 2022 Enrollment Estimates by Undergraduate Program

Excludes CNED

Prepared by OPAA 2/22/2022

HegisCode	@1stMajPlan	Returning Students and New Transfers					Total
		New FTS	FR	SO	JR	SR	
040100	BIOL-BS	75	39	91	87	62	353
049905	BIOI-BS	2	1	1	5	4	13
050601	BUAD-BS	159	104	206	209	144	823
060500	COMM-BA/BS	25	23	61	83	60	253
060501	VCDMA-BS	51	41	54	53	46	245
070100	COSC-BS	76	45	64	67	37	289
079903	CTEC-BS	43	41	77	80	71	312
080200	ELED-BS	18	11	27	44	45	144
082300	ECED-BS	17	18	21	34	24	114
083400	SCIE-BS	3	1	1	3	1	9
083504	SPM-BS	32	24	50	32	33	171
100100	ARTS-BA	29	22	27	11	9	99
100700	THEA-BS	9	7	8	8	9	42
120300	NURS-BS	149	108	117	123	46	542
150100	ENGL-BA/BS	7	3	19	13	15	57
170100	MATH-BS	2	2	4	7	1	17
190500	CHEM-BS	2	1	4	2	1	10
200101	PSYC-BA/BS	63	39	80	105	82	370
210400	SOWK-BS	19	21	38	32	31	141
210500	CRJU-BA/BS	82	61	99	116	96	454
220500	HIST GOV BA/BS	5	2	10	26	14	57
220802	SOCI-BA/BS	5	4	7	15	29	61
499900	CAAS-BA	3	3	18	18	17	59
909901	UNDE	73	33	42	27	3	178
Grand Total		950	653	1127	1201	880	4812

## Fall 2021 Enrollment by Undergraduate Program

Excludes CNED

Prepared by OPAA 2/22/2022

HegisCode	@1stMajPlan	Returning Students and New Transfers					Total
		New FTS	FR	SO	JR	SR	
040100	BIOL-BS	72	66	88	75	95	396
049905	BIOI-BS	2	0	3	4	8	17
050601	BUAD-BS	153	125	221	214	257	970
060500	COMM-BA/BS	24	22	81	89	100	316
060501	VCDMA-BS	49	22	56	57	64	248
070100	COSC-BS	73	34	56	48	31	242
079903	CTEC-BS	41	52	76	81	110	360
080200	ELED-BS	17	18	29	50	61	175
082300	ECED-BS	16	14	26	33	46	135
083400	SCIE-BS	3	0	2	1	3	9
083504	SPM-BS	31	33	43	44	40	191
100100	ARTS-BA	28	25	19	13	15	100
100700	THEA-BS	9	2	13	14	3	41
120300	NURS-BS	143	90	153	111	46	543
150100	ENGL-BA/BS	7	6	11	21	16	61
170100	MATH-BS	2	3	5	9	4	23
190500	CHEM-BS	2	1	1	2	1	7
200101	PSYC-BA/BS	61	41	93	108	106	409
210400	SOWK-BS	18	20	43	37	31	149
210500	CRJU-BA/BS	79	54	118	123	110	484
220500	HIST GOV BA/BS	5	6	10	32	21	74
220802	SOCI-BA/BS	5	5	12	26	27	75
499900	CAAS-BA	3	3	16	26	24	72
909901	UNDE	70	45	48	15	4	182
Grand Total		913	687	1223	1233	1223	5279

### Notes:

New

Students: FTS program market share will be the same as fall 2021

TRAN program by level market share will be the same as fall 2021

Assumptions Spring to Fall return Rates will be at spr21/fall 21 levels

All seniors with 120+ credits will graduate

New students (FTS and TRN) will be distributed in the same manner as the fall 21 semester

Does not

include: Students who stopped out during the spring 2022 semester



## A quote for your consideration

Based on your business needs, we put the following quote together to help with your purchase decision. Below is a detailed summary of the quote we've created to help you with your purchase decision.

To proceed with this quote, you may respond to this email, order online through your [Premier page](#), or, if you do not have Premier, use this [Quote to Order](#).

<b>Quote No.</b>	<b>3000110116513.1</b>	Sales Rep	Kimberly Turner
<b>Total</b>	<b>\$271,308.00</b>	Phone	(800) 456-3355, 6180255
Customer #	527322	Email	Kimberly_Turner@Dell.com
Quoted On	Jan. 21, 2022	<b>Billing To</b>	ACCOUNTS PAYABLE
Expires by	Feb. 20, 2022		BOWIE STATE UNIV
Contract Name	MEEC IT Hardware		14000 JERICHO PARK RD
	Contract		BOWIE, MD 20715-3319
Contract Code	C000000011270		
Customer Agreement #	UMD-972016		

### Message from your Sales Rep

Please contact your Dell sales representative if you have any questions or when you're ready to place an order. Thank you for shopping with Dell!

Regards,  
Kimberly Turner

### Shipping Group

Shipping To	Shipping Method
BSU RECV BSU RECV BOWIE STATE UNIV CENTRAL RECEIVING 14000 JERICHO PARK RD BOWIE, MD 20715-3319 (301) 860-3485	Standard Ground

Product	Unit Price	Quantity	Subtotal
Precision 5820 Tower	\$2,433.79	100	\$243,379.00
Dell UltraSharp 24 Monitor - U2422H, 60.47cm (23.8")	\$279.29	100	\$27,929.00

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<b>Subtotal:</b>	<b>\$271,308.00</b>
<b>Shipping:</b>	<b>\$0.00</b>
<b>Environmental Fee:</b>	<b>\$0.00</b>
<b>Non-Taxable Amount:</b>	<b>\$271,308.00</b>
<b>Taxable Amount:</b>	<b>\$0.00</b>
<b>Estimated Tax:</b>	<b>\$0.00</b>
<hr/>	
<b>Total:</b>	<b>\$271,308.00</b>

Special lease pricing may be available for qualified customers. Please contact your DFS Sales Representative for details.

## Shipping Group Details

### Shipping To

BUSI REC'D BSU REC'D  
 BOWIE STATE UNIV  
 CENTRAL RECEIVING  
 14000 JERICHO PARK RD  
 BOWIE, MD 20715-3319  
 (301) 860-3485

### Shipping Method

Standard Ground

	Quantity	Subtotal
<b>Precision 5820 Tower</b>	<b>100</b>	<b>\$243,379.00</b>
Estimated delivery if purchased today: Mar. 07, 2022 Contract # C000000011270 Customer Agreement # UMD-972016		

Description	SKU	Unit Price	Quantity	Subtotal
Precision 5820 Tower XCTO Base	210-ANJK	-	100	-
Intel (R) Core (TM) i9-10900X 3.7GHz,(4.7GHz Turbo, 10C, 19.25MB Cache, HT, (165W), DDR4-2933 Non-ECC)	338-BUNV	-	100	-
Intel(R) Core(TM) i9 Label	389-CGEV	-	100	-
CPU Heatsink 5820 Tower	412-AALF	-	100	-
Windows 10 Pro (Includes Windows 11 Pro License) English, French, Spanish	619-AQDH	-	100	-
No Microsoft Office License Included – 30 day Trial Offer Only	658-BCSB	-	100	-
Precision 5820 Tower Core X 950W Chassis CL FMX	321-BGTL	-	100	-
Nvidia RTX A2000, 6GB, 4 mDP to DP adapter (Precision 7920R, 7920T, 7820, 5820, 3930)	490-BHQC	-	100	-
32GB, 2x16GB, DDR4 UDIMM non-ECC memory	370-AFGF	-	100	-
No Out-of-Band Systems Management	631-ABML	-	100	-
SATA/SAS Hard Drive/Solid State Drive	449-BBLT	-	100	-
Integrated Intel AHCI SATA chipset controller (8x 6.0Gb/s), SW RAID 0,1,5,10	403-BBRL	-	100	-
3.5" 1TB 7200rpm SATA Hard Drive	400-ASSK	-	100	-
3.5" 4TB 7200rpm SATA AG-Enterprise Hard Drive	400-AZZC	-	100	-
No Hard Drive	400-AKZR	-	100	-
No Hard Drive	400-AKZR	-	100	-
No Optical	429-ABER	-	100	-
No Hard Drive	400-AKZR	-	100	-
No Hard Drive	400-AKZR	-	100	-
No RAID	780-BBCJ	-	100	-
Slim ODD bezel, 100% tie with slim ODD	325-BCUD	-	100	-
8x DVD+/-RW 9.5mm Optical Disk Drive	429-ABDW	-	100	-
CMS Essentials DVD no Media	658-BBTV	-	100	-
GPT is 100% required for all order	411-XXYB	-	100	-
Dell KB216 Wired Keyboard English	580-ADJC	-	100	-
Dell Optical Mouse - MS116 (Black)	570-ABIE	-	100	-
Thank You for Choosing Dell	340-ADBJ	-	100	-

1Gbit NIC add-in card (PCIe- Intel)	540-BBZY	-	100	-
No Driver	555-BBNI	-	100	-
Not selected in this configuration	817-BBBC	-	100	-
Trusted Platform Module (Discrete TPM Enabled)	329-BBJL	-	100	-
US Power Cord	470-AAKG	-	100	-
SERI Guide (ENG/FR/Multi)	340-AGIK	-	100	-
Placemat 5820 Tower MUI DAO	340-BYNM	-	100	-
Resource DVD not Included	430-XXYU	-	100	-
OS-Windows Media Not Included	620-AALW	-	100	-
Not ENERGY STAR Qualified	387-BBBE	-	100	-
Dell Optimizer for Precision	640-BBSC	-	100	-
No Driver	555-BBNI	-	100	-
US Order	332-1286	-	100	-
No UPC Label	389-BCGW	-	100	-
Ship Material Tower 5820,7820	328-BCRU	-	100	-
SHIP,PWS,LNK,NO,NO,AMF	340-AEYP	-	100	-
T5820 950W Regulatory Label (DAO)	389-CGKH	-	100	-
No Stand included	575-BBCH	-	100	-
No Accessories	461-AABV	-	100	-
Performance Optimized	370-AAIP	-	100	-
BIOS match checked back to factory	444-BBBG	-	100	-
BIOS binary check enabled and verified	444-BBBS	-	100	-
SupportAssist	525-BBCL	-	100	-
Dell(TM) Digital Delivery Cirrus Client	640-BBLW	-	100	-
Enable Low Power Mode	658-BBMQ	-	100	-
Dell Developed Recovery Environment	658-BCUV	-	100	-
External Speaker Not Included	520-AABF	-	100	-
No Anti-Virus Software	650-AAAM	-	100	-
No AutoPilot	340-CKSZ	-	100	-
Thank you choosing Dell ProSupport. For tech support, visit //support.dell.com/ProSupport	989-3449	-	100	-
Dell Limited Hardware Warranty Plus Service	997-7163	-	100	-
ProSupport: Next Business Day Onsite 5 Years	997-7191	-	100	-
ProSupport: 7x24 Technical Support, 5 Years	997-7211	-	100	-

			<b>Quantity</b>	<b>Subtotal</b>
<b>Dell UltraSharp 24 Monitor - U2422H, 60.47cm (23.8")</b>		<b>\$279.29</b>	<b>100</b>	<b>\$27,929.00</b>

Estimated delivery if purchased today:  
Feb. 21, 2022  
Contract # C000000011270  
Customer Agreement # UMD-972016

Description	SKU	Unit Price	Quantity	Subtotal
Dell UltraSharp 24 Monitor - U2422H, 60.47cm (23.8")	210-AYYV	-	100	-
Dell Limited Hardware Warranty	814-5380	-	100	-
Advanced Exchange Service, 3 Years	814-5381	-	100	-

<b>Subtotal:</b>	<b>\$271,308.00</b>
<b>Shipping:</b>	<b>\$0.00</b>
<b>Environmental Fee:</b>	<b>\$0.00</b>
<b>Estimated Tax:</b>	<b>\$0.00</b>
<hr/>	
<b>Total:</b>	<b>\$271,308.00</b>



## Important Notes

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### Terms of Sale

This Quote will, if Customer issues a purchase order for the quoted items that is accepted by Supplier, constitute a contract between the entity issuing this Quote ("Supplier") and the entity to whom this Quote was issued ("Customer"). Unless otherwise stated herein, pricing is valid for thirty days from the date of this Quote. All product, pricing and other information is based on the latest information available and is subject to change. Supplier reserves the right to cancel this Quote and Customer purchase orders arising from pricing errors. Taxes and/or freight charges listed on this Quote are only estimates. The final amounts shall be stated on the relevant invoice. Additional freight charges will be applied if Customer requests expedited shipping. Please indicate any tax exemption status on your purchase order and send your tax exemption certificate to [Tax\\_Department@dell.com](mailto:Tax_Department@dell.com) or [ARSalesTax@emc.com](mailto:ARSalesTax@emc.com), as applicable.

**Governing Terms:** This Quote is subject to: (a) a separate written agreement between Customer or Customer's affiliate and Supplier or a Supplier's affiliate to the extent that it expressly applies to the products and/or services in this Quote or, to the extent there is no such agreement, to the applicable set of Dell's Terms of Sale (available at [www.dell.com/terms](http://www.dell.com/terms) or [www.dell.com/oemterms](http://www.dell.com/oemterms)), or for cloud/as-a-Service offerings, the applicable cloud terms of service (identified on the Offer Specific Terms referenced below); and (b) the terms referenced herein (collectively, the "Governing Terms"). Different Governing Terms may apply to different products and services on this Quote. The Governing Terms apply to the exclusion of all terms and conditions incorporated in or referred to in any documentation submitted by Customer to Supplier.

**Supplier Software Licenses and Services Descriptions:** Customer's use of any Supplier software is subject to the license terms accompanying the software, or in the absence of accompanying terms, the applicable terms posted on [www.Dell.com/eula](http://www.Dell.com/eula). Descriptions and terms for Supplier-branded standard services are stated at [www.dell.com/servicecontracts/global](http://www.dell.com/servicecontracts/global) or for certain infrastructure products at [www.dellemc.com/en-us/customer-services/product-warranty-and-service-descriptions.htm](http://www.dellemc.com/en-us/customer-services/product-warranty-and-service-descriptions.htm).

**Offer-Specific, Third Party and Program Specific Terms:** Customer's use of third-party software is subject to the license terms that accompany the software. Certain Supplier-branded and third-party products and services listed on this Quote are subject to additional, specific terms stated on [www.dell.com/offeringspecificterms](http://www.dell.com/offeringspecificterms) ("Offer Specific Terms").

**In case of Resale only:** Should Customer procure any products or services for resale, whether on standalone basis or as part of a solution, Customer shall include the applicable software license terms, services terms, and/or offer-specific terms in a written agreement with the end-user and provide written evidence of doing so upon receipt of request from Supplier.

**In case of Financing only:** If Customer intends to enter into a financing arrangement ("Financing Agreement") for the products and/or services on this Quote with Dell Financial Services LLC or other funding source pre-approved by Supplier ("FS"), Customer may issue its purchase order to Supplier or to FS. If issued to FS, Supplier will fulfill and invoice FS upon confirmation that: (a) FS intends to enter into a Financing Agreement with Customer for this order; and (b) FS agrees to procure these items from Supplier. Notwithstanding the Financing Agreement, Customer's use (and Customer's resale of and the end-user's use) of these items in the order is subject to the applicable governing agreement between Customer and Supplier, except that title shall transfer from Supplier to FS instead of to Customer. If FS notifies Supplier after shipment that Customer is no longer pursuing a Financing Agreement for these items, or if Customer fails to enter into such Financing Agreement within 120 days after shipment by Supplier, Customer shall promptly pay the Supplier invoice amounts directly to Supplier.

Customer represents that this transaction does not involve: (a) use of U.S. Government funds; (b) use by or resale to the U.S. Government; or (c) maintenance and support of the product(s) listed in this document within classified spaces. Customer further represents that this transaction does not require Supplier's compliance with any statute, regulation or information technology standard applicable to a U.S. Government procurement.

For certain products shipped to end users in California, a State Environmental Fee will be applied to Customer's invoice. Supplier encourages customers to dispose of electronic equipment properly.

Electronically linked terms and descriptions are available in hard copy upon request.

## Appendix D

### Course Descriptions

This Master of Science in IoT & Internet Technologies in the Department of Technology & Security will comprehensively prepare students for further advanced coursework in biotechnology and other bioscience disciplines and prepare them to be a part of the future STEM workforce. This program is also designed to develop soft skills such as innovative thinking, ability to work with diverse teams, which is desirable both in academic and industrial settings.

#### Courses

##### **CTEC 621 Edge Technologies Architecture (3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course teaches students how to utilize data from sensors and other remote devices. Students will institute essential IoT concepts, tools, and methodology using hands-on experience using the Intel Nervana AI Academy online environment and tool set stacks of the IoT kit and the Raspberry Pi. These experiences include building prototypes of devices at the edge of the Internet, typically referred to as The Internet of Things (IoT).

##### **CTEC 641 Internet Technologies Discovery (3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course identifies, collects, and preserves electronically stored information (ESI) and data from a range of IoT devices, such as smartwatches, medical devices, vehicles, doorbells, Amazon (Alexa, Dash, Alexa Echo Plus), home mesh WiFi systems, and cellular-based IoT devices. Students will have hands-on laboratory experience that focuses on digital evidence, data recovery, and logging methods to trace back cyber-attacks.

##### **CTEC 651 Internet of Things Digital Repository (3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

This course will build a scalable SQL Server machine that aggregates data items from separate databases into one centralized location.

##### **CTEC 661 Satellite and Mobile Communication (3 credits)**

**Prerequisite CTEC 335, CTEC 120, CTEC 220, CTEC 230, CTEC 302, CTEC 345**

In this course, the student will learn the fundamentals and techniques for designing and analyzing satellite communication systems and mobile and wireless communication to include 5G broadband cellular networks.

##### **CTEC 671 Smart Integrated Systems (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This class builds a blockchain machine that utilizes and addresses real-world problems and addresses core research topics in the smart industry.

##### **CTEC 681 – Fog and Edge Computing (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course enables the students to start building and creating IoT devices from scratch for home automation, building security, and assisted living use cases. This course touches all the necessary connections and components such as software, hardware, platform, protocols, edge computing, fog computing, and everything in between.

##### **CTEC 691 – Internet of Things Ecosystem and Analytics (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course describes the components of the IoT Ecosystem and investigates real-time solutions for effective decision making.

**CTEC 701 - Hardware-Oriented Security and Trust (3 credits)**

**Prerequisite CTEC 721 & CTEC 641**

This course investigates recent technology developments to design and evaluate secure and trustworthy hardware. Hardware security and trust techniques are required to ensure that chips remain secure and trustworthy during their entire lifecycle from design to manufacturing, deployment, service, and retirement. The following topics are covered in this course and their application to the Internet-of-Things (IoT): autonomous cars, smart homes, smart grid, factory automation, innovative infrastructure, and cloud computing.

**CTEC 711 Internet of Things Capstone I (3 credits)**

**Prerequisite Graduate Standing and Permission of Instructor**

Major team-based software design project to be undertaken in a student's final year of study; project planning, software requirements analysis, design, and specification. Written reports and oral presentations in a technical setting.

**CTEC 712 Internet of Things Capstone II (3 credits)**

**Prerequisite CTEC 711**

Continuation of CTEC 711. Computer system implementation, testing, verification and validation of results. Written reports and oral presentations in a technical setting.

**CTEC 720 Master's Thesis Research I (3 credits)**

**Co-Requisite CTEC 711**

In this course, students will apply relevant evidence-based research to content from earlier courses in the master's program and integrate technology infrastructure perspectives. Students are expected to develop scholar-practitioner competencies for applying systematic technology theories and practices through the lens of innovation and consider topics such as systems integration and IoT infrastructure as they complete the stages of the thesis writing process.

**CTEC 721 Master's Thesis Research II (3 credits)**

**Co-Requisite – CTEC 711 and Prerequisite CTEC 720**

This course is a continuation of CTEC 720. In this course, students will continue to apply relevant evidence-based research to content from earlier courses in the master's program and integrate technology infrastructure perspectives. Students are expected to further develop scholar-practitioner competencies for applying systematic technology theories and practices through the lens of innovation and consider topics such as systems integration and IoT infrastructure as they complete the final stages of the thesis writing process.