CAPITOL TECHNOLOGY UNIVERSITY

1927

Bradford L. Sims, PhD
President

September 27, 2017

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

Dear Dr. Fielder,

This letter is in response to the need for confirmation of the adequacy of the library of Capitol Technology University to support the proposed Bachelor of Science (B.S.) in Unmanned and Autonomous Systems. As president of the university, I confirm that the library resources, including support staff, are more than adequate to support the B.S. in Unmanned and Autonomous Systems. In addition, the university is dedicated to, and has budgeted for, continuous improvement of library resources.

Respectfully,

Bradford L. Sims, PhD

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Dr. James D. Fielder, Jr.
Secretary of Maryland Higher Education
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6 N. Liberty Street
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Dear Dr. Fielder,

Capitol Technology University is requesting approval to offer a **Bachelor of Science (B.S.) in Unmanned and Autonomous Systems**. The degree curriculum utilizes a significant number of existing courses in our university's curricula and is supplemented by new courses supporting the B.S. in Unmanned and Autonomous Systems.

The mission of Capitol Technology University is to provide practical education in engineering, computer science, information technology, and business that prepares individuals for professional careers and affords the opportunity to thrive in a dynamic world. A central focus of the university's mission is to advance practical working knowledge in areas of interest to students and prospective employers within the context of Capitol's degree programs. The university believes that a B.S. in Unmanned and Autonomous Systems is consistent with this mission.

Unmanned and Autonomous Systems is a specific need identified by industry and government communities. According to industry experts, Unmanned and Autonomous Systems is a skill set of increasing value to employers. It is desirable across many fields, across a variety of job categories and levels of employment. A critical gap between the supply and demand of skilled Unmanned and Autonomous Systems professionals is already reaching crisis proportions. Increasing demand, in turn, translates into a growing need for universities and other academic institutions to develop a program that educates Unmanned and Autonomous Systems professionals at all levels and for all industries.

To respond to industry need, we respectfully submit for approval a Bachelor of Science in Unmanned and Autonomous Systems. The required proposal is attached as is the letter from me as university president confirming the adequacy of the university's library to serve the needs of the students in this degree.

Respectfully,

Bradford L. Sims, PhD

PROPOSAL FOR:

__X__NEW INSTRUCTIONAL PROGRAM

_____ SUBSTANTIAL EXPANSION/MAJOR MODIFICATION

_____ COOPERATIVE DEGREE PROGRAM

__X__WITHIN EXISTING RESOURCES or____REQUIRING NEW RESOURCES

CAPITOL TECHNOLOGY UNIVERSITY

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Institution Submitting Proposal

Fall 2018
Projected Implementation Date

Bachelor of Science
Award to be Offered

Unmanned and Autonomous Systems
Title of Proposed Program

Suggested HEGIS Code

Suggested CIP Code

Electrical Engineering
Department of Proposed Program

Professor Nayef Abu-Ageel
Name of Department Head

Dr. Helen Barker	**hgbarker@captechu.edu**	**240-965-2510**
VP Academic Affairs, CAO	Contact E-Mail Address	Contact Phone Number

9-27-17
Signature and Date

President/Chief Executive Approval

9-27-2017
Date

Date Endorsed/Approved by Governing Board

Proposed Bachelor of Science in Unmanned and Autonomous Systems
Department of Electrical Engineering
Capitol Technology University
Laurel, Maryland

A. Centrality to institutional mission statement and planning priorities:

1. Program description and relationship to university mission and how it relates to the institution's approved mission.

Unmanned and Autonomous Systems Program Description:

The Bachelor of Science (B.S.) degree in Unmanned and Autonomous Systems (UAS) provides the student with the necessary knowledge and training to become a professional in the diverse field of Unmanned and Autonomous Systems. The degree provides a firm foundation in Unmanned and Autonomous Systems flight operations, mission planning, special sensors, weapons, surveillance and data collection, aeronautical engineering, aeronautical technologies and ground control. Students will design, construct, and fly an Unmanned Aerial Vehicle (UAV). Students of the program will be able to become a certified Unmanned Aerial Systems Operator and will have the knowledge and skills to support governmental and commercial employers. The Unmanned and Autonomous Systems core courses will prepare students to pass the Federal Aviation Administration (FAA) Part 107 test to become a Commercial UAV Pilot and Sport Pilot.

Relationship to Institutional Approved Mission:

The B.S. in Unmanned and Autonomous Systems is consistent with the University mission to educate individuals for professional opportunities in engineering, computer science, information technology, and business. We provide relevant learning experiences that lead to success in the evolving global community. Fundamental to the degree programs in the Department of Electrical Engineering are opportunities to produce skilled systems-oriented UAS operators, designers, planners, and maintainers. The B.S. in Unmanned and Autonomous Systems is consistent with that philosophy. This same philosophy is supported by existing degree programs and learning opportunities. The degree is an integral part of the strategic plan for FY 2019-2020 and forward. Funding to support the new degree has been included in institutional and departmental budgets for FY 2018-2019 and forecasted budgets going forward.

The degree will be offered in the traditional classroom environment as well as in hybrid [simultaneous online (synchronous) and traditional classroom] format. This results in the convenience required by the 21st century learner, and provides live interaction with faculty and fellow students critical to the high-level learning experience. The curriculum provides students real-world opportunities through labs, case studies, and an internship, thereby providing the student the necessary practical experience the University believes critical to success in the modern aviation environments. The degree is consistent with the interdisciplinary nature of the University as well as the field of Electrical Engineering. This opportunity will be available to all University students.

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

Capitol Technology University operates on five strategic goals:

1. **Elevating Education and Academic Quality:** *The University is an institution that offers career relevant curriculum with quality learning outcomes.*
2. **Expand Enrollment and Reputation:** *The University will become more globally renowned and locally active through student, faculty, and staff activities.*
3. **Diversify and Increase Financial Resources**: *The University will enhance its financial resources by expanding the range and amount of funding available to the institution, aligning costs with strategic initiatives, and expanding corporate relationships.*
4. **Maintain Institutional Viability**: *The University is committed to providing relevant learning in a quality learning environment.*
5. **Extend Our Family of Organizational Partners**: *The mission of Capitol Technology University is to provide relevant learning experiences that lead to success in the evolving global community.*

This new instructional program supports all of the university's five strategic goals. It does so, in part, because of the cross disciplinary nature of the program. This approach builds upon already successful areas of study, such as the Bachelor of Science in Astronautical Engineering degree, which integrates space systems engineering, orbital mechanics, spacecraft subsystems, spacecraft altitude and control, autonomous ground systems as well as other areas of satellite mission planning, design, and operation. Capitol Technology University's programs are structured to teach students the leadership and technical skills necessary to meet the needs of a modern technology-dependent society. These programs have been preparing professionals for rapid advances in technology, intense global competition, and more complex technical environments for decades. The B.S. in Unmanned and Autonomous Systems degree allows our students to move their skills and careers to the next level within the evolving global technical community.

The new B.S. in Unmanned and Autonomous Systems is fully supported by the university's Vision 2025 and Strategic Plan 2017-2021. Funding to support the degree has been included in forecasted budgets going forward.

The University has active partnerships (e.g., Leidos, Patton Electronics, Lockheed Martin, Northrup Grumman, and Cyber Security Forum Initiative, IRS, SAS) at the private and public level. The Unmanned and Autonomous Systems degree will provide new opportunities for partnerships as well as research. Potential partnerships for internships were identified at the most recent job fair held at the University. The increase in partnerships and placement of our interns and graduates in our partner institutions will serve to expand the university's enrollment and reputation. While additional enrollment will increase financial resources, additional partnerships and grants in this field of study will help diversify and increase financial resources.

With more and more companies relying on video, data, and information from UAVs, the demand for skilled designers, maintainers, and operators is expected to grow exponentially. Currently, the most common use of Unmanned and Autonomous Systems is in real estate, aerial photography,

agriculture, construction, utility inspection, film/TV, environmental research, and law enforcement. However, companies in retail goods (e.g., Amazon), mining, wildlife research and management are already planning to make Unmanned Aerial Systems an integral part of their operations. Other sectors of commerce as well as federal state, and local governments are quickly drawing up plans to do so as well. The demand for Unmanned and Autonomous Systems personnel is rapidly growing and resulting in a shortage of potential employees. The B.S. in Unmanned and Autonomous Systems degree answers the growing demand for highly trained personnel in Unmanned and Autonomous Systems -- making the degree extremely relevant now and in the future.

B. 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 advancement and evolution of knowledge.**

Our nation, state, and society are on the verge of a huge explosion of growth and change due to the emergence of Unmanned and Autonomous Systems. Capitol Technology University believes it is imperative to position the state to take advantage of the coming changes, rather than waiting on the sidelines. A recent article on the Economist.com website explains the forces at work right now and predicts the upcoming transformation will happen relatively quickly when compared to other technological changes in the past.

"Information and communication technology—as it exists right now, not even assuming future progress—offer the potential for similar bursts of growth. Growth will take similarly transformative reorganisations [sic] within society and across geographies…That's another reason the burden of knowledge issue is less of a concern…than it may be to others. Advancement of the scientific frontier is growing more difficult. Yet deployment of existing technologies to more productive ends may well be growing easier. Consider the tacocopter. The tacocopter is a not-quite-real-not-quite-a-joke business idea that became a brief internet sensation back in March [2016]. The concept is stunningly simple: order tacos on your iPhone and a quadracopter drone will deliver them to your doorstep. As you can read here, the plan would face technical and (especially) regulatory hurdles if implemented today. Yet the potential, for this or similar experiments, is obvious. Cheap, agile drone technology is available now. Building apps is trivially easy. Mapping and location technology and data are getting better all the time."

Source: https://www.economist.com/blogs/freeexchange/2012/06/innovation

"While privacy and safety concerns persist, it seems clear that the world will see more, not less drones in the future. According to the Association of Unmanned Vehicle Systems International, a trade group promoting drone use, the FAA has approved drone operators in 48 states…"

Source: http://fortune.com/2015/08/25/advanced-drone-degree/

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

Capitol Technology University has a long history of serving the minority population. The

university has a 51% minority student population with 7% undisclosed. Thirty-four percent of our minority population is African American.

"The drone industry is in its infancy, which experts say makes now the right time to talk about workforce diversity.

Thomas Wilczek, the aerospace and defense industry representative for the state of Nevada, moderated a panel on the subject…helping to close a three-day convention dedicated to commercial drones.

'Diversity is a competitive advantage,' said Las Vegas Assemblywoman Irene Bustamante Adams to a crowd of about 25 InterDrone attendees. 'It's an untapped business strategy, but the ones that figure it out go from being a local to a national, global-type of company.' As the industry emerges, it's important to think about the changing workforce that will fill future positions, she said."

Source: https://www.reviewjournal.com/life/workforce-diversity-seen-as-key-for-future-of-drone-industry/

"We're truly excited about drones for many reasons," he said. "We believe we're truly on the verge of drone revolution."

Intel CEO Brian Krzanich "also discussed Intel's goal of 'full representation of women and underrepresented minorities' by 2020.

"If we want the technology industry to define the future, we must be representative of that future," he explained. "We must represent the consumers and populations we service, and this genuinely leads to better business results."."

Source: https://www.channelnomics.com/channelnomics-us/news/2440822/intel-ceo-talks-up-drones-diversity-at-ces

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

The 2013-2017 Maryland State Plan for Postsecondary Education articulates six goals for postsecondary education:

1. Quality and Effectiveness
2. Access, Affordability, and Completion
3. Diversity
4. Innovation
5. Economic Growth and Vitality
6. Data Use and Distribution

Goal 1

The B.S. in Unmanned and Autonomous Systems program, with its rigor, will produce highly qualified aviation professionals for this emerging field of study and employment. The university has a proven record of quality education. In addition to regional accreditation, the Association of Technology, Management, and Applied Engineering (ATMAE) accredits technology, management, and applied engineering degrees. The B.S. in Unmanned and Autonomous Systems program is consistent with the ATMAE criteria for the delivery of high quality technology, management, and applied engineering education. Faculty and staff are engaged in faculty development to remain current in their field of teaching as well as to expand knowledge across disciplines. The university has in place services and learning tools to guide students to successful degree completion. Programs such as Early Alert provide staff and faculty opportunities for early student intervention in the pathway to graduation. This applies to all students regardless of mode of course delivery. Capitol is a transfer friendly institution and participates in multiple programs for government and military credit transfer. Capitol participates in Artsys and has multiple transfer agreements with local institutions at all degree levels.

Goal 2

The courses for the B.S. in Unmanned and Autonomous Systems will be offered in the traditional classroom environment as well as in online hybrid format (simultaneous real-time synchronous online combined with a live traditional classroom). This provides learning opportunities for students unable or unwilling to attend an on-campus institution of higher education. The University provides a tuition structure that is competitive with its competitors. The University tuition structure does not differentiate between in-state and out-of-state students. Student services are designed to provide advising, tutoring, virtual job fair attendance, and other activities supporting student completion and employment for both on-ground and online students.

Students receive information through admissions regarding the cost to attend the university. The information is also publicly available on the university website. Admissions and financial aid identify potential grants, scholarships, and state plans for the student to reduce potential student debt. The net cost versus gross costs are identified clearly for the student. Students receive advising from financial aid prior to enrolling in classes for the first time. Admissions, student services and departmental chairs advise students of the need for academic readiness as well as the degree requirements. A specific success pathway is developed for each student.

The university tuition increases have not exceeded 3%. The university has a tuition lock, which means full-time tuition is locked at the rate applied at time of enrollment. The tuition remains at this rate if the student remains enrolled full-time without a break in attendance.

The university has in place student services, tutoring, and other tools to help ensure student graduation and successful job placement. The university has a job placement guarantee, which is supported by mandatory personal and professional growth opportunities.

The university works with its advisory boards, alumni, partners, and faculty to help ensure that the degrees offered at the university are compatible with long-term career opportunities and support of the state's knowledge-based economy.

Goal 3

The Capitol Technology University community is committed to creating and maintaining a mutually respectful environment that recognizes and celebrates diversity among all students, faculty, and staff. The university values human differences as an asset and works to sustain a culture that reflects the interests, contributions, and perspectives of members of diverse groups. The university delivers educational programming to meet the needs of diverse audiences. We also seek to instill those values, understanding, and skills to encourage leadership and service in a global multicultural society.

The university supports various clubs that identify with diverse groups including race, gender, military/veterans, and sexual orientation. The university has a 51% minority student population with 7% undisclosed. Thirty-four percent of our minority population is African American. The university has a military/veteran population of 22%. The university has a 17% female population, which is significant given its status as a technology university.

Achievement gaps: The university provides summer remedial programs offering students with math and English deficiencies to take those courses at no charge the summer prior to entering the university. Free housing is available for these students. This program provides students the opportunity to enter the freshman year at an improved academic readiness level. There are also situations where the state's community colleges best serve student needs in these areas. The university partners with the local community colleges to allow students to get increased support after which, under a transfer agreement, the student transfers back to the university.

The university engages in diversity training for its institutional population, including students. Diversity and inclusiveness are built in to the curriculum allowing graduates to operate effectively in a global environment. The university supports such things a team projects and grants across degrees. This has proven effective at supporting multiple aspects of diversity.

Goal 4

Capitol Technology University's past, present, and future is inextricably intertwined with innovation. The university has a long tradition of serving as a platform for the use of new and transformative approaches to delivering higher education. New technology and cutting-edge techniques are blended with proven strategies with the goal of enabling student success in the classroom as well as in a successful career after graduation. As a small institution, Capitol Technology University has the agility to rapidly integrate new technologies into the curriculum to better prepare students for the work environment. The university designs curriculum in alliance with accreditation and regulating organizations/agencies.

The university also employs online virtual simulations in a game-like environment to teach practical hands-on application of knowledge. The university is engaged with a partner creating high level virtual reality environments for some courses in the degree. This use of current technology all occurs in parallel with traditional proven learning strategies. These elements of the university learning environment are purposeful and intended to improve the learning environment for both the student and faculty member. In addition, these elements are intentionally designed to increase engagement, improve outcomes, and improve retention and graduation rates. The university believes that innovation is the key to successful student and faculty engagement.

Example: The university engages its students in 'fusion' projects, which allows students to contribute their skills in interdisciplinary projects such as those in our Astronautical Engineering and Cyber labs students become designers, builders, and project managers (to send a CubeSAT on a NASA rocket) and data analysts (to analyze rainforest data for NASA). We are recruiting partners for this potential degree in Unmanned and Autonomous Systems for which real projects will provide students integrative learning opportunities.

The university supports prior learning assessment. Portfolio analysis is available. The university accepts professional certifications for credit for specific courses. In addition, the university allows students to take a competency exam for credit for required courses up to the current state limits.

Goal 5

One of the overarching principles of Capitol Technology University's approach to education is to instill a zeal for life-long learning in our students, which promotes economic growth and the vitality of the student. Analytics inherently supports a knowledge based economy. University partnerships both current and future will provide economic growth opportunities for its students, the university, and its partners. The university's Ph.D. in Management and Decision Sciences provides opportunities for undergraduate students to engage in high level research partnerships. The university is committed to partnering with Maryland institutions to employ our graduates to keep the talent in the state. The university instills in students an entrepreneurial attitude preparing them to bring skills to startup businesses or start a business of their own.

Goal 6

Capitol Technology University is committed to data collection and disclosure beyond the requirements of regulations and accreditation. Data is publicly available on the university website. Assessment for the university is the responsibility of the Vice President (VP) of Academic Affairs. The university employs highly skilled personnel to accumulate data, analyze the data, distribute the results, and recommend potential decisions in a timely manner to achieve the desired outcomes. In addition, data is evaluated by the dean, chairs, faculty, advisory boards, trustees, university executives, etc. to make the best decision possible for the university and state.

C. Quantifiable & reliable evidence and documentation of market supply and demand in the region and State:

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

"If you want to pull in a six-figure salary right out of school, you might want to start studying unmanned aircraft systems, more commonly and controversially known as drones. The young field is already lucrative—$11.3 billion globally—and set to grow exponentially. The Association for Unmanned Vehicle Systems International, a trade organization, predicts that the global market will be $140 billion in 10 years."

Source: http://www.slate.com/blogs/business_insider/2014/09/24/drone_college_new_undergraduate_degrees_in_unmanned_aircraft_systems_pay.html

"The high salaries [for unmanned and autonomous systems personnel] relate to the specialization and travel that comes with the job. 'If it involves overseas deployment, starting salary is close to six figures, $80,000 plus deployment pay, an additional compensation package for being deployed and having to spend six months out of the year sequestered away in Afghanistan,' (Kurt) Barnhart says. Domestic jobs — with startup companies like Roboflight or Precision Hawk—start at about $60,000 a year. Compare that with first-year pilots of conventional aircraft; they start out at as low as $21,000 a year.

Philip Ellerbroek, Roboflight's global director of sales, says that charting a career in UAS requires understanding the facets of the field. You could design the hardware itself, train in piloting the aircraft, or write software code to make the whole thing work. You also have to factor in scale of the vehicle itself: Flying a hobbyist plane won't require a degree, but if you want to pilot a $4 million military device like a Predator, you need specialization."

Source: http://www.slate.com/blogs/business_insider/2014/09/24/drone_college_new_under graduate_degrees_in_unmanned_aircraft_systems_pay.html

"While most of the news about UAS centers around their military applications, experts say the growth is going to come through private work in the US, whether it's farmers inspecting fields, meteorologists investigating hurricanes, or construction workers surveying sites."

Source: http://www.slate.com/blogs/business_insider/2014/09/24/drone_college_new_under graduate_degrees_in_unmanned_aircraft_systems_pay.html

The following is a sample business case for an effective use of Unmanned and Autonomous Systems to increase a farmer's yield and profits.

"Agriculture Business Start-up: Crop farming in the USA makes an annual profit of $150 billion. One of the major expenses is chemical application. Chemicals consist of fertilizer, pesticides, fungicides and herbicides. If the amount of chemical usage can be reduced, farmers' profits will increase. A UA/Drone can use specialized sensors to discover non-fertile areas, plant disease and weed infestations. Instead of applying chemicals to the entire farm, only apply chemicals to affected areas detected by a UA/Drone. A total of $26 billion is spent on fertilizer every year. If UA/Drone usage can save 30%, an increase of $8.7 billion in profits can be realized. A very cheap off-the-shelf vegetation stress camera (like the XNiteCannonSX230NDVI 12 megapixel with GPS) can easily be mounted on a UA/Drone to capture a Normalized Difference Vegetation Index (NDVI) image."

Source: http://www.uxvuniversity.com/uapa/

"It sounds futuristic: a drone carrying a defibrillator swooping in to help bystanders revive someone stricken by cardiac arrest.

Researchers tested the idea and found that drones arrived at the scene of 18 cardiac arrests within about 5 minutes of launch. That was almost 17 minutes faster, on average, than ambulances — a big deal when minutes mean life or death.

Cardiac arrest is a leading cause of death worldwide, killing more than 6 million people each year. Most cases happen at home or in other non-medical settings, and most patients don't survive.

'Ninety percent of people who collapse outside of a hospital don't make it. This is a crisis, and it's time we do something different to address it,' said the cardiology chief at Northwestern University's medical school.

[R]esearchers reached the same conclusion after analyzing cardiac arrest data in Sweden, focusing on towns near Stockholm that don't have enough emergency medical resources to serve summer vacationers. The analysis found an emergency response time of almost 30 minutes and a survival rate of zero, said lead author Andreas Claesson, a researcher at the Center for Resuscitation Science at Karolinska Institute in Stockholm.

Heart attacks occur when a clot or other blockage stops blood flow to the heart. Cardiac arrest occurs when electrical impulses controlling the heart's rhythmic pumping action suddenly malfunction. The heartbeat becomes very irregular or stops, preventing blood from reaching vital organs. Death can occur within minutes without treatment to restore a normal heartbeat, ideally CPR and use of a defibrillator.

The researchers used a small heart defibrillator weighing less than two pounds, with an electronic voice that gives instructions. It was attached to a small drone equipped with four propeller-like rotors, a global positioning device, and a camera.

'Drones are increasingly being tested or used in a variety of settings, including to deliver retail goods in remote areas, search for lost hikers, and help police monitor traffic or crowds. Using them to speed medical care seemed like a logical next step…'"

Source: https://www.bostonglobe.com/business/2017/06/13/drones-with-defibrillators-could-soon-fly-rescue-cardiac-arrests/X6kfwxjsR1jN5cv3acLtwO/story.html

"Like the internet and GPS before them, drones are evolving beyond their military origin to become powerful business tools. They've already made the leap to the consumer market, and now they're being put to work in commercial and civil government applications from firefighting to farming. That's creating a market opportunity that's too large to ignore.

Between now and 2020, we forecast a $100 billion market opportunity for drones—helped by growing demand from the commercial and civil government sectors.

Drones got their start as safer, cheaper and often more capable alternatives to manned military aircraft. Defense will remain the largest market for the foreseeable future as global competition heats up and technology continues to improve.

The consumer drone market was the first to develop outside the military. Demand has taken off in the last two years and hobbyist drones have become a familiar sight, but there is plenty of room for growth.

The fastest growth opportunity comes from businesses and civil governments. They're just beginning to explore the possibilities, but we expect they'll spend $13 billion on drones between now and 2020, putting thousands of them in the sky."

DRONES AT WORK: BUSINESS & CIVIL GOVERNMENT

Drones are already generating climate data, monitoring the borders and more—and they're just scratching the surface of their commercial potential.

THE JOB OPPORTUNITIES
Total Addressable Market by Industry/Function
(Millions of Dollars)

- Construction $11,164
- Agriculture $5,922
- Insurance Claims $1,418

• Offshore Oil/Gas and Refining	$1,110
• Police (US)	$885
• Fire (US)	$881
• Coast Guard (US)	$511
• Journalism	$480
• Customs and Border Protection (US)	$380
• Real Estate	$265
• Utilities	$93
• Pipelines	$41
• Mining	$40
• Clean Energy	$25
• Cinematography	$21

Source: Goldman Sachs Research

Source: http://www.goldmansachs.com/our-thinking/technology-driving-innovation/drones/

2. **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.**

There has been dramatic growth throughout the United States in the numbers and use of unmanned aircraft during recent years. The commercial and military impact UAV's will have in the coming years is very significant, creating more than 100,000 new jobs by 2025, with an economic impact of $82 billion, according to a 2013 report by the Association for Unmanned Vehicle Systems International (a group representing 7,500 individual members and 600 corporations). The U.S. budget for drone warfare has increased from $667 million in 2002 to more than $3.9 billion, according to the Congressional Research Service. And the number of drones in military service has increased from 167 to nearly 7,500.

Source: https://successfulstudent.org/15-best-drone-training-colleges/

Analysts at PricewaterhouseCoopers predicted last year that the global market for commercial applications of drone technology could reach $127 million by 2020, rather than 2025 as predicted by the Association for Unmanned Vehicle Systems International (AUVSI).

Source: https://www.theatlantic.com/technology/archive/2017/01/drone-pilot-school/515022/

According to the Maryland Department of Commerce report, "UAS and Maryland Accountability document, A Report Connected to the Unmanned Aircraft Systems Research Development, Regulation and Privacy Act of 2015," the AUVSI estimate in 2013 for the number of available jobs for manufacturing alone in by 2025 would be 34,000. The AUVSI organization now anticipates 100,000 jobs in UAS manufacturing alone within a decade of airspace integration.

Source: http://www.flyingmag.com/careers/growing-job-demand-unmanned-aerial-systems#page-2

According to the Maryland Department of Commerce report, Maryland has an impressive base of aerospace and UAS companies, ranking fourth nationally in the number of firms, following

California, Florida and Virginia. The broader Maryland/Virginia region combined represents an even stronger concentration. Many area firms have been active in the Defense UAS market since its inception and are investing in developing commercial capabilities. Among the larger players are Lockheed and Northrup Grumman, which house complementary UAS functions in the state. Maryland also has a robust start-up environment in modeling, simulation and big data analytics, an integral piece of the Unmanned and Autonomous Systems world. (Note: This is consistent with the existing and new analytics studies opportunities at Capitol.)

Career opportunities for students with drone training include military drone pilot, firefighter, disaster relief, search and rescue, law enforcement, oil and gas operations, seismic study, border patrol, traffic reporting, storm chasing, agriculture, package delivery, forestry, engineering, computer science, commercial contractors, film, and other industries. Companies that hire drone engineers and pilots include aerospace and defense companies Northrop Grumman and Lockheed Martin, and aircraft manufacturer Boeing. NASA is currently working on an air traffic control system for drones, and online retail giant Amazon is ready to deliver packages via drones.

Source: https://successfulstudent.org/15-best-drone-training-colleges/

Unmanned systems can be a critical part of an emergency management system: Per FEMA, "FEMA staff should review pre-disaster maintenance or inspection reports to verify pre-disaster conditions and to assess eligible disaster damage for facilities that require routine maintenance to maintain their designated function before allocating any money for recovery." Given the dynamics of disaster relief, evidence is required of the pre-disaster status of an area. If your community does not have the documentation to prove that all damage was caused by the disaster (and not a result of pre-existing conditions), then your community could be left without the needed recovery funds from the FEMA public assistance program. Drones can be utilized to fly over key infrastructure to document pre-disaster conditions via video and image capture either annually or right before a known storm to ensure that your community has the necessary documentation for FEMA. This could be key to thousands of dollars, if not more in some situations.

Source: http://www.cdrmaguire.com/why-drones-are-valuable-to-your-emergency-management-plan/

Companies such as Amazon and Google are testing ways to deliver packages via drone in the future.

In an economic impact assessment two years ago, AUVSI projected more than $2 billion in economic gains and more than 2,700 new UAS-related jobs in Ohio and an $82 billion market and 100,000 jobs in the United States within 10 years once drones are flying under Federal Aviation Administration rules.

Source: http://www.govtech.com/budget-finance/Drone-Related-Job-Growth-to-Outpace-Predictions.html

Interest groups are banding together for permissions to use drones.

The movie makers have been joined by groups like the National Association of Broadcasters and

National Association of Realtors wanting permission to use drones as a platform for photography, according to the records.

An association representing rural and farming interests, the National Grange of the Order of Patrons of Husbandry, began lobbying in favor of greater drone use in agriculture and other applications last year, according to its reports.

Source: https://www.bloomberg.com/news/articles/2014-05-12/filmmakers-to-farmers-seeking-drone-bonanza-in-washington?cmpid=mashable

3. **Data showing the current and projected supply of prospective graduates.**

The increase in use of drones commercially is estimated to boom by more than 6,000 percent by the end of the decade according to Bloomberg.com. PricewaterhouseCoopers LLP has also reported that the global market for commercial uses of drone technology, currently estimated at about $2 billion, will grow to around $127 billion by the year 2020. The state of Maryland, according to the Maryland Department of Commerce, wants to be a leader in this field. The state of Maryland is encouraging industry and government to participate actively in developing the regulations that will allow this industry to explode, according to the UAS and Maryland Accountability document, "A Report Connected to the Unmanned Aircraft Systems Research Development, Regulation and Privacy Act of 2015." The report notes that there will be a move from engineers in this job category to unmanned systems educated individuals who have the hands-on experience desired.

The data on the current and projected supply of graduates was not located for this MHEC request. However, the information identifying the current and future demand speaks to the need for higher education based training in this field.

The field is in its infancy in terms of its application outside the military. There are currently 2,500 non-cleared governmental jobs in Unmanned and Autonomous Systems available on Indeed.com. This number does not account for other for-profit job sites, recruiting agencies, and private employment sites. The current job market is significantly short of the expected demand due to the current regulations. However, industry experts expect that supportive regulations will allow the market to explode with opportunities for careers in the field. Capitol Technology University intends to respond proactively to the expected need with the B.S. in Unmanned and Autonomous Systems degree. Our students will be well positioned to respond to all Maryland and national initiatives in this field. It is important to also note that there are international initiatives in this field that will create international employment opportunities through partnerships with Maryland organizations.

D. Reasonableness of program duplication:

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

There are no similar programs in the State or same geographical area. University of Maryland (UMD) has a Bachelor of Science in Aerospace Engineering. However, the program is not

focused on Unmanned and Autonomous Systems and does not have courses in Unmanned and Autonomous Systems.

Capitol Technology University's B.S. in Unmanned and Autonomous Systems degree focuses specifically on Unmanned and Autonomous Systems and is not a broader Bachelor of Science in Aerospace Engineering. Capitol Technology University's B.S. in Unmanned and Autonomous Systems degree will be delivered through a mix of traditional classroom, online (live, synchronous), and hybrid courses.

2. **Provide justification for the proposed program.**

The program is strongly aligned with the university's strategic priorities and is supported by adequate resources. The new B.S. in Unmanned and Autonomous Systems degree will strengthen and expand upon existing technology, management, and applied engineering degree programs at the university. In addition, the Unmanned and Autonomous Systems courses will be an option for all students as the field integrates well with the market needs of the university's other technical programs. The degree will represent study in a rapidly changing and expanding discipline. Research shows a current and growing shortage of Unmanned and Autonomous Systems operators, engineers, designers, and maintainers. This program helps fill those gaps.

There is a thorough discussion of the need in sections B and C of this document.

E. Relevance to high-demand programs at Historically Black Institutions (HBIs):

1. **Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBIs.**

The university is not aware of any similar high-demand programs at the Maryland HBIs.

F. 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.**

The university is not aware of any impact on the uniqueness and institutional identities and missions of Maryland HBIs.

G. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation .10 of this chapter:

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

Program description, as it will appear in the catalog:

The Bachelor of Science (B.S.) degree in Unmanned and Autonomous Systems (UAS) provides the student with the necessary knowledge and training to become a professional in the diverse field of Unmanned and Autonomous Systems. The degree provides a firm foundation in Unmanned and Autonomous Systems flight operations, mission planning, special sensors,

weapons, surveillance and data collection, aeronautical engineering, aeronautical technologies and ground control. Students will design, construct, and fly an Unmanned Aerial Vehicle (UAV). Students of the program will be able to become a certified Unmanned Aerial Systems Operator and will have the knowledge and skills to support governmental and commercial employers. The Unmanned and Autonomous Systems core courses will prepare students to pass the Federal Aviation Administration (FAA) Part 107 test to become a Commercial UAV Pilot and Sport Pilot.

Description of program requirements:

Entrance requirements: Have earned a high school diploma or GED. Students must have achieved a minimum of a 2.2 GPA in high school. Submit official transcripts of all prior academic work completed at community colleges, colleges, or universities you've attended. Submit SAT (minimum 800) or ACT (minimum 15) scores. Interview with a Capitol admission counselor. There are no special criteria for this degree.

To be eligible to be graduated by the university students must have successfully completed all program course requirements, be in good academic standing (GPA 2.0 or higher), satisfied all financial obligations, any other outstanding obligations to the university.

Degree Requirements:

The following is a list of courses for the B.S. in Unmanned and Autonomous Systems degree. Students expecting to complete this degree must meet all prerequisites for the courses listed below.

TECHNICAL – 46 CREDITS
UNMANNED AND AUTONOMOUS SYSTEMS CORE COURSES

UAS-101 Introduction to Unmanned and Autonomous Systems (3 credits)
This course presents an introduction to Unmanned and Autonomous Systems operations. This includes a historical perspective and background information of this system including its: modeling and control fundamentals, ground based systems, visual and electro-optical aspects of navigation, obstacle and terrain avoidance systems, modular on-board processing systems, and current applications. This course also exposes students to the significant regulations impacting unmanned systems operations.
Prerequisite: None.

UAS-102 Mechanics of Unmanned and Autonomous Systems (3 credits)
This course will provide the student an understanding of the component systems common to most Unmanned and Autonomous Systems with an emphasis on effective integration and operations. The course focuses on the core technologies and includes examinations of the control systems, power plants (motors), servos/actuators, power sources, and communication technologies utilized in unmanned systems.
Prerequisite: None.

EL-100 Introduction to DC/AC Circuits (3 credits)
This course presents basic electrical concepts and laboratory techniques. Current, voltage, resistance and power. Ohm's law, series and parallel resistive circuits. Kirchhoff's voltage and

current laws. Loading effects on meters and supplies. Capacitors and Inductors. Charging and discharging. RC and RL time constants. Introduction to AC. Sinusional waveforms, phasors and use of the J operator. Reactance and admittance. Average values and RMS. Laboratory emphasis is on the proper use of standard meters, testing equipment and circuit breadboarding. MATLAB Part I: Introduction to MATLAB, variables, MATLAB functions, data types, writing a MATLAB program, using basic plotting functions.
Prerequisite: MA-112 or higher.

UAS-110 Air Traffic Control Communications (3 credits)
This course presents an overview of the history of air traffic control, air traffic control tower procedures, radar systems, radar separation, radio communications and techniques, flight plan clearances, traffic management and emergency procedures and priority handling survey.
Prerequisite: UAS-101, UAS-102.

UAS-120 UAS Operator Certification (4 credits)
The course will develop the student's knowledge and skills that are needed to safely exercise the privileges and responsibilities of a Private Pilot. Course content includes instruction in aerodynamics, aircraft systems, FAA regulations, U.S. Airspace System, weight and balance, aircraft performance, aviation weather, flight publications, radio navigation, cross-country planning and navigation, basic flight physiology, and flight safety. The student must complete the appropriate flight lessons to satisfactorily complete the course. This course will develop the student's knowledge and skill needed to manage and operate small unmanned aircraft systems. Course content includes Federal Aviation Regulations, airspace authorization criteria, and operational approval requirements. Mission employment skills will be acquired through both classroom and hands-on flight activities. Flight activities will include launch and recovery operations, emergency procedures, plus mission planning and execution. Students must complete the appropriate UAS flight lessons to satisfactorily complete the course.
Prerequisite: None.

UAS-130 Unmanned and Autonomous Systems Safety Management Systems (3 credits)
This course presents an overview of related unmanned and autonomous safety topics, including current safety issues, the role of federal agencies, accident statistics, causes of accidents, human factors, crew resource management skills, and accident prevention.
Prerequisite: UAS-101, UAS-102, UAS-310.

UAS-140 Unmanned Systems Operational Interaction and Control (3 credits)
This course serves as an overview of the concepts and principles affecting operational interaction and control of unmanned systems. Students will explore the principles of command, control, and communications (C3) as the foundation to design, planning, and interactions of standalone and interoperable (human-system and system-system) processes in centralized and distributed models. Attention will be given to considerations relating to the development, configuration, and application of individual and multi-unmanned system solutions and behavior used in teleoperated (manual), autonomous, and cooperative/collaborative operations.
Prerequisite: UAS-120.

UAS-150 Unmanned Systems Human Factors Considerations (3 credits)
This course serves as an overview of human factors concepts and implications affecting the development, configuration, and application of unmanned systems. Students will be exposed to types and functions of human-machine-interfaces (HMI)s; human behavior, capabilities, and

limitations; psychological and perceptual information processing; sensation, cognition, and ergonomics; and effects of autonomy. Attention will be given to considerations relating to the development, configuration, and application of HMIs used for command, control, and communication (C3), autonomous operation, and the review and manipulation of sensor data.
Prerequisite: UAS-140.

UAS-201 Unmanned and Autonomous Systems Sensing Technology (3 credits)
This course provides an overview of the technology and concepts used to remotely gather information about an unmanned system's operating environment. Students will examine the fundamental concepts and methods of sensing systems including the type, format, and capabilities of sensors; component and system integration; use cases; challenges and issues; and emerging concepts. Attention will be given to tools and methods used to support development, configuration, and application of sensing systems. Students will gain hands-on experience through complex mission planning assignments and guided discussion.
Prerequisite: UAS-101, UAS-102.

UAS-202 Unmanned Ground Systems and Applications (3 credits)
This course provides students with an introduction to the fundamental concepts and commonly applied technology used for unmanned ground systems (UGS). Students are exposed to an historical perspective, control fundamentals, control systems, mobility methods, sensor systems, and applications such as agriculture, search and rescue, firefighting, construction, mining, and others. Attention will be given to tools and methods used to support development, configuration, and application of UGS to conduct operations of appropriate vehicles, sensors, and payloads in terrestrial environments.
Prerequisite: UAS-140.

UAS-210 Unmanned and Autonomous Systems Networking (3 credits)
This course is a study of the information technology, communications, and frequency spectrum used in conjunction with unmanned systems around the world. Students explore signal processing, communications, interfaces, data links/exchange, FCC regulations, interoperability, and communication standards and protocols associated with robotic systems. Attention will be given to tools and methods used to support development, configuration, and application of unmanned systems individual and networked operations through communication and information processing of signals and data.
Prerequisite: UAS-140.

UAS-220 Introduction to Processing Remotely Sensed Data (3 credits)
Students are introduced to basic theory, history, and practical applications of remote sensing technology, with an emphasis on high spatial resolution multispectral aerial imagery collected using unmanned aircraft systems. Other topics include geographic information systems, aerial image interpretation, sensor resolution, orthomosaicing, georegistration, vegetation indices, and image classification.
Prerequisite: UAS—201.

UAS-230 Unmanned Maritime Systems and Applications (3 credits)
This course provides students with an introduction to the fundamental concepts and commonly applied technology used for unmanned maritime systems (UMS). Students are exposed to an historical perspective, control fundamentals, control systems, surface and underwater methods, sensor systems, and applications such as search and locate, inspection, construction, and others.

Attention will be given to tools and methods used to support development, configuration, and application of UMS to conduct operations of appropriate vehicles, sensors, and payloads in marine environments.
Prerequisite: UAS-140.

UAS-240 Unmanned Space Systems and Applications (3 credits)
This course will introduce students to the fundamentals and commonly applied technology for unmanned space systems. Historical perspectives, current developments, and possible future concepts will be discussed. Students will be exposed to unmanned space system specific considerations of craft design requirements, maneuvering fundamentals and control systems, and payload selection. A fundamental knowledge base in space navigation and orbital maneuvering will be provided. This course builds on other unmanned systems courses (as defined in prerequisites). Previously introduced unmanned systems operational domains (air, space, ground, and maritime) will be applied towards exploration of extraterrestrial celestial bodies, such as planets, moons, comets, and asteroids. Attention will be given to the conceptual understanding of current and future challenges in unmanned space system development and employment.
Prerequisite: UAS-150, UAS-220.

UAS-250 Unmanned and Autonomous Systems Operational Environments & Conditions (3 credits)
This course provides an overview of complex environmental issues and conditions with respect to factors affecting performance and appropriateness of platform and associated components. Students are introduced to concepts of matching the mission purpose and the environment/conditions with the design and capabilities of an unmanned system. Elements of extreme temperature, terrain, weather, pressure, range, and required endurance are explored. Attention will be given to considerations relating to the development, configuration, and application of correctly identified robotic solutions based on problem sets, environments, conditions, and operational types.
Prerequisite: UAS-140.

GENERAL EDUCATION - 24 CREDITS

EN-101 English Communications I (3 credits)
This introductory college-level course focuses on effective oral and written communication skills and the development of analytical abilities through various reading and writing assignments. Students must demonstrate competence in writing mechanics, including grammar, sentence structure, logical content development, and research documentation through 2 essays and 2 research papers. Rhetorical modes may include description, comparison/contrast, narrative, and process analysis. Students are expected to develop effective oral communication skills through speeches. Group projects will develop effective team skills such as decision-making, time management, and cooperation.
Prerequisite: acceptance based on placement test scores.

EN-102 English Communications II (3 credits)
This sequel to EN-101 involves more sophisticated reading, writing, speaking, and research assignments. Students must demonstrate competence in writing mechanics, as well as advanced research skills, the ability to handle complex information, and effective team skills. Students write research papers: an information paper, a cause-and-effect paper, an argument paper, and a final research paper. Course includes group work. Presentations are required.

Prerequisite: EN-101.

HU-331 Arts and Ideas (3 credits) or HU-332 (not both)
This course enables students to study and appreciate various forms of art, including painting, sculpture, architecture, music, drama, film, and literature through in-class and on-site experiences. The arts are also surveyed from an historical perspective, focusing primarily on eras in Western civilization. This enables students to sense the parallel development of the arts, of philosophy, and of sociopolitical systems and to recognize various ways of viewing reality.
Prerequisite: EN-102.

HU-332 Arts and Ideas: Special Topics (3 credits) or HU-331 (not both)
This course has the same general requirements as HU-331, but the orientation of the course will be on alternate traditions to the Western canon. Students will study various forms of art, including painting, sculpture, architecture, music, drama, film, and literature through in-class and on-site experience. Students will gain an appreciation for the arts as they are represented by a particular culture or national identity. The course will concentrate on how the arts are shaped by cultural/social forces the result in distinct philosophies and ideologies.
Prerequisite: EN-102.

SS-351 Ethics (3 credits)
This course is designed to help students improve their ability to make ethical decisions. This is done by providing a framework that enables the student to identify, analyze, and resolve ethical issues that arise when making decisions. Case analysis is a primary tool of this course.
Prerequisite: EN-102.

EN-408 English Writing Seminar in Technical Research (3 credits)
This course prepares the student for the Senior Design course. It requires the application of certain basic principles in developing documentation needed for technical communication. Each student must be able to identify a particular problem and devise a proposal for solving it. A series of written assignments should provide a thorough literature review and analysis of relevant issues, expert opinions, and the author's (student's) recommendations for solving the problem. Students are also expected to present their work via oral presentations.
Prerequisite: EN-102 and Senior status (i.e., earned 96 or greater credits).

Social Sciences (SS) Elective – one course (3 credits)

Humanities (HU) Electives – two courses (6 credits)

MATHEMATICS - 10 CREDITS

MA-114 Algebra and Trigonometry (4 credits)
Designed for students needing mathematical skills and concepts for MA-261. Topics covered in algebra include algebra: basic operations on real and complex numbers, fractions, exponents and radicals, determinates, solution of linear, fractional, quadratic and system equations. Topics covered in trigonometry include: definition and identities, angular measurements, solving triangles, vectors, graphs and logarithms.
Prerequisite: MA-112 or acceptance based on placement test score.

MA-128 Introduction to Statistics (3 credits)
Topics covered in probability include: definitions, theorems, permutations and combinations. Binomial, hypergeometric, Poisson and normal distributions. Topics covered in sampling include: distribution and central limit theorem, estimation and hypothesis testing.
Prerequisite: MA-114.

MA-124 Discrete Mathematics (3 credits)
Topics covered include Logic sets and sequences; algorithms, divisibility and matrices; proof, induction and recursion; counting methods and probability; relations, closure and equivalence relations, graphs and trees; Boolean algebra.
Prerequisite: MA-114 or acceptance based on placement test score.

PHYSICAL SCIENCES - 9 CREDITS

PH-201 General Physics I (3 credits)
Non calculus-based physics intended for credit in engineering technology courses.
Topics covered include mechanics: units, conversion factors: vector diagrams, translational equilibrium, friction, torque and rotational equilibrium: uniformly accelerated motion, projectiles: Newton's Law, work energy and power: kinetic and potential energy, conservation of energy: impulse and momentum. Heat: temperature scales, thermal properties of matter, heat and temperature change, heat and change of phase, physics of heat transfer; applications.
Prerequisite: MA-114.

PH-202 General Physics II (3 credits)
Non calculus-based physics intended for credit in engineering technology courses. Topics covered include light and sound: wave motion, nature of light, reflection and mirrors, refraction, prisms, dispersion lenses; simple harmonic motion; sound transmission, resonance, interference, Doppler Effect. Electricity and magnetism: static electricity, electric fields, magnetic fields, electric potential capacitance; electricity in motion; magnetic induction; electromagnetic relations. Alternating currents.
Prerequisite: PH-201.

AE-390 Aviation Meteorology (3 credits)
Prepares students with the knowledge necessary to comprehend the fundamentals of meteorology, analyze weather factors, hazards and in-flight weather conditions and weather conditions as they relate to aircraft and flight performance using aviation meteorology charts and internet weather resources.
Prerequisite: None.

MANAGEMENT - 15 CREDITS

UAS-310 Unmanned and Autonomous Systems Operations and Mission Planning (3 credits)
This course will introduce undergraduate students to specific aspects of unmanned and autonomous systems mission planning in support of task-oriented operations. Attention will be given to tools, methods, and skills used to support selection, configuration, and application processes during planning, pre-operations, during operations (monitoring and data-gathering), post-operations, and post-processing procedures. A comprehensive understanding of current systems and operating requirements will be reviewed and navigation concepts and components

introduced. Unmanned systems contain a variety of packages that are unique to the environment in which they operate. The student will identify the system packages available, and determine their proper operation during unmanned systems applications.
Prerequisite: UAS-101, UAS-102.

UAS-320 Operational and Business Aspects of Unmanned Aerial Systems (3 credits)
This course will prepare the student to differentiate the applicable needs of civil aviation for UAS. It will examine each of the particular needs and address how to implement the UASs to fill that need within the constraints of the current national airspace and federal aviation regulation restrictions. Particular attention will be given to skill sets and tools used to mitigate restrictions and to create a flight operation that can successfully employ UASs.
Prerequisite: UAS-120, UAS-310.

UAS-330 Unmanned Systems Crew Resource Management (3 credits)
Principles of organizational behavior, interpersonal relationship skills, and critical behavioral dynamics used by Unmanned Aircraft Systems (UAS) crews. Information processing, Human Error, Communications Processes, Problem Solving, Workload Management, and Situational Awareness with particular attention given to dealing with teleoperation and automation in UAS application.
Prerequisite: UAS-310.

UAS-410 Unmanned and Autonomous Systems Legal and Regulatory Compliance (3 credits)
This course introduces students to the wide ranging legal requirements, regulations, and policies affecting the development and application of unmanned systems across various operational domains (air, space, maritime, and ground). It features examination of current legal frameworks and domain specific rules; compliance enforcement; challenges and issues; case examples; processes for change; intellectual property and design; and emerging concepts. Unique factors and challenges that impact domain specific types of unmanned systems such as unmanned aerial systems (UAS) and autonomous automobiles will be addressed. Attention will be given to those laws, regulations, and policies relating to the development, configuration, and application of command, control, and communication (C3), autonomous operation, and the capture and review of sensor data.
Prerequisite: UAS-320.

UAS-458 Unmanned and Autonomous Systems Mission Capstone Project (3 credits)
This course is a continuation of EN-408 into the Capstone Project implementation phase. Students work on their Capstone Project, submit progress reports, and engineering reports. Students are required to pass an unmanned system design review. Students are also required to make a detailed presentation of the Capstone Project with oral and written reports.
Prerequisite: EN-408 and Senior status (earned 96 or greater credits).

GENERAL ELECTIVES (ALL REQUIRED) - 18 CREDITS

CS-150 Introduction to Computer Programming using C (3 credits)
This introductory course in programming will enable students to understand how computers translate basic human instructions into machine executable applications. The language of choice for this course is C. The C syntax that will be covered includes functions; variables and memory

allocations including pointer notation; conditional statements and looping. Students will also learn binary to hexadecimal and decimal conversions along with basic computer architecture. Memory management, data input output and file manipulations will be among some other topics discussed and applied during this course.
Prerequisite: MA-112 and CS-100.

CS-220 Database Management (3 credits)
This course is an overview of database systems, with an emphasis on relational databases. Terminology, basic analysis and design using Entity-Relationship diagrams and relational schemas. Database implementation, queries and updates in a modern relational database management system. An overview of database administration, transactions and concurrency. Data warehouses. Projects, which are assigned as homework, are implemented in Oracle.
Prerequisite: A grade of C or better in CS-130 or CS-150.

CT-206 Scripting Languages: Python (3 credits)
Introduces students to the use of scripting and the scripting languages of Perl and Python. The class will cover the use of scripting to solve short problems, automate routine tasks, integrate across pieces of software, and prototype code ideas. The merits of code-complete design versus on-the-fly coding as well as coding and code documentation styles will be discussed. Tasks involving input/out, regular expressions, and file operations are included. Students are expected to fully script solutions for real-world tasks assigned as part of the course.
Prerequisites: CS-130 OR CS-150.

IAE-201 Introduction to Information Assurance Concepts (3 credits)
This course covers topics related to administration of network security. Topics include a survey of encryption and authentication algorithms; threats to security; operating system security; IP security; user authentication schemes; web security; email security protocols; intrusion detections; viruses; firewalls; Virtual Private Networks; network management and security policies and procedures. Laboratory projects are assigned as part of the homework requirements. This course prepares students for the (ISC)2 Systems Security Certified Practitioner (SSCP) Certification. Co-requisites: MA-110 or MA-112 or MA-114 or MA-261.

UAS-420 Data Acquisition and Post-processing
Students build upon the basic image processing skills gained in the previous course, expanding their knowledge of common aerial image data processing tasks using industry-standard software packages. Aerial data collection methodologies are introduced, including consideration of aerial mission flight parameters. Prerequisite: UAS-220.

UAS-430 Unmanned and Autonomous Systems Data Visualization and Presentation
This course combines the science of data visualization for Unmanned and Autonomous Systems (UAS) with the art of graphic design to help you communicate complex information more accurately and effectively. By transforming UAS data sets into visual graphics—such as charts, bar graphs, scatterplots, and, heatmaps—you can make complex ideas more easily accessible and understandable. Through hands-on exercises, students will explore the many types of data in use today, learn how people perceive different graphical displays, and create visual presentations that make a stronger impact on your audience. Students will learn how to translate simple and complex data into effective visual displays, communicate more precisely by pinpointing the most relevant information, and apply effective methods for analyzing, presenting, and using statistical data. Students will also learn to identify the strengths and weaknesses of different data

visualization approaches and avoid creating misleading representations of data—and being misled by others.
Prerequisite: UAS-420.

2. Describe the educational objectives and intended student learning outcomes.

Educational Objectives:

a. Students will be able to plan for the employment of the major types, groups, and categories of Unmanned and Autonomous Systems.
b. Students will be able demonstrate all aspects of the Unmanned and Autonomous Systems flight approval and authorization process.
c. Students will be to recognize the legal and ethical considerations for specific types of Unmanned and Autonomous Systems operations and demonstrate appropriate actions.
d. Students will be able to employ the multiple types of sensors used for data collection aboard Unmanned and Autonomous Systems.
e. Students will be able to compare, contrast and employ the types of detect, sense and avoid systems.
f. Students will be able to differentiate the various levels of UAS automation and autonomy.
g. Students will be able demonstrate the proper UAS safety procedures.

Learning Outcomes:

Upon graduation:

a. Graduates will be able to analyze the fundamentals of unmanned and autonomous systems, including the technological, social, environmental, and political aspects of the system to examine, compare, analyze and recommend conclusions.
b. Graduates will be able to compare and contrast current unmanned and autonomous system issues, identify contributing factors, and formulate strategies to address or further investigate.
c. Graduates will be to evaluate and recommend the incorporation of new technologies, methods, processes, or concepts with current unmanned system applications, management practices, or operational policies.
d. Graduates will be able to critically justify and validate unmanned and autonomous system design configurations to support safe, efficient, and effective operations in applicable domains (air, space, ground, and maritime), including assessing appropriateness of major elemental components, evaluating limitations and constraints, formulating theory of operation, and supporting the perceived need.
e. Graduates will be able to effectively communicate concepts, designs, theories, and supporting material with others in the unmanned and autonomous systems field.
f. Graduates will be able to investigate current unmanned systems problems, complete a thorough review of the issue, formulate hypotheses; collect and appropriately analyze data, interpret the findings, and provide a report to others in the field.
g. Graduates will be able to improve the field of unmanned and autonomous systems and provide solutions to an unmanned and autonomous systems challenges.

3. **Discuss how general education requirements will be met, if applicable.**

   General education requirements will be met in an integrated manner along with the degree specific requirements. Beginning in the first semester of the first year, students take both general education requirements as well as degree specific courses. This methodology continues throughout the undergraduate curriculum until all general education requirements have been fulfilled. A student must satisfy all the requirements of the program, both general education and degree specific, in order to graduate. This process is consistent with other undergraduate degrees at the university.

4. **Identify any specialized accreditation or graduate certification requirements for this program and its students.**

   The program will be accredited regionally by Middle States and the Association of Technology, Management, and Applied Engineering (ATMAE).

5. **If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**

   The university will not be contracting with another institution of non-collegiate organization.

H. Adequacy of articulation:

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

   Currently this program does not have articulation partners. However, it is expected that articulation will work as it does for the university's current degrees. The university is very active with its transfer partners throughout the state and beyond. The goal of the university is to work with partners to make transfer as seamless as possible and to maximize transfer credits as allowable. There are dedicated transfer student personnel to guide this process.

I. Adequacy of faculty resources (as outlined in COMAR 13B.02.03.11):

1. **Provide a brief narrative demonstrating the quality of the 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.**

   All faculty listed below have been engaged with the college for at least several years. Ashmall, Antunes, Bajracharya, Bajwa, Barker, Mehri, Opeka, Pittman, Rankin and Sabbah are fulltime faculty members. The majority of the faculty hold terminal degrees. Moss, Andrews, Perry, McElyea, and Pomper work in the fields associated with analytics. The university leadership is confident in the quality of the faculty and their abilities to provide a learning environment supportive of the goals of the university for student success. Additional qualified faculty will be added as needed.

   The faculty listed below do not include those already engaged with the university to teach English, Liberal Art & Humanities, or Social Sciences.

INSTRUCTOR	BACKGROUND	COURSES ALIGNED TO BE TAUGHT
Dr. Audrey Andrews Adjunct	D.M. Organizational Leadership M.S. Information Systems Management M.B.A.	BUS 240, BUS 246, BUS 376, BUS 393, BUS 395, BUS 174, BUS 275, BUS 279, BUS 376, BUS 386, BUS 410, BUS 458
Dr. Alex "Sandy" Antunes Full time	Ph.D., Computational Astrophysics	AE 351, AE 390, CT 206, PH 261
Lt. Col Soren Ashmall, USMC (Ret.) Full time	M.A. Broadcast Journalism B.A. Theatre MOS 3450 Planning, Programming, & Budget Systems Officer MOS 8055 Information Management Officer MOS 0202 Intelligence Officer MOS 2602 Signals Intelligence Officer/Ground Electronic Warfare Officer Licensed Real Estate Agent/REALTOR Facilities Security Officer, National Industrial Security Program (NISP)	BUS 200, BUS 275, BUS 279, BUS 280, BUS 281, BUS 410, SS 351
Dr. Chandra Bajracharya Full-time	Ph.D., Electrical and Computer Engineering M.S., Applied Computing M.S., Electrical Power Engineering B.E., Electrical Engineering	CS 100, EE 458, EL 200, EL 261
Dr. Garima Bajwa Full time	Ph.D., Computer Science and Engineering M.S., Electrical and Computer Engineering B.S., Electronics and Communication Engineering	CS 150, CT 206, EL 100
Dr. Richard Baker Adjunct	Ph.D., Information Systems M.S., Computer Science B.S., Mathematics F-4 Pilot	All UAS Courses
Dr. Hasna Banu Adjunct	Ph.D. Theoretical Physics M.S. Mathematics B.S. Mathematics	MA 114, MA 261, MA 262, MA 263, BUS 443

Tommy Bargsley Adjunct	MBA Applied Management B.B.A. Accounting Chartered Global Management Accountant (CGMA) CPA	BUS 270, BUS 271
Dr. Helen Barker Full time	D.M. Organizational Leadership M.S. Information Systems Management M.S. Business Administration	BUS 240, BUS 246, BUS 376, BUS 393, BUS 395, BUS 375
Dr. Malcolm Beckett Adjunct	D.B.A. Quality Systems Management in Homeland Security and Defense M.S. Information Systems Management	BUS 240, BUS 250, BUS 310, BUS 443
Dr. Kristen Broz Adjunct	J.D. B.A. History and English	BUS 378
William Flood Adjunct	M.A. Business (Entrepreneurship) M. S. Ed Human Resources, Education, & Public Policy B.S. Secondary Ed	BUS 174, BUS 275, BUS 279, BUS 289, BUS 376, BUS 386, BUS 410, BUS 458
Bradley Hewitt Adjunct	M.B.A. B.S. Business Administration	BUS 174, BUS 275, BUS 279, BUS 376, BUS 386, BUS 410, BUS 458
Dr. George Hoffman Adjunct	D.B.A. M.S. System Management B.S. Engineering Technology	BUS 310, BUS 367, BUS 443
Darryl Lesesne Adjunct	M.S. Accounting & Financial Management B.B.A. Accounting Certified Bank Auditor (CBA) CFSA CGFA	BUS 270, BUS 271
Dr. Priscilla Lewis Adjunct	D.M. Leadership M.B.A. and M.P.S. Managerial Policy B.S. Economics/Mathematics	BUS 240, BUS 246, BUS 376, BUS 289, BUS 393, BUS 395, BUS 282
Dr. Brian McElyea Adjunct	Ph.D. Leadership and Organizational Change; Specialization: Knowledge Management	BUS 240, BUS 250, BUS 247, BUS 284, BUS 310, BUS 458
Andrew Mehri Full time	M.B.A. M.S. Information Assurance B.S. Engineering Technology	BUS 174, BUS 275, BUS 279, BUS 376, BUS 386, BUS 410, BUS 458, CS 100, CS 150, CS 200, CS 220, CT 240, NT 100

Anthony Miller Adjunct	M.B.A. B.S. Marketing	BUS 367, BUS 376, BUS 393
Dr. John Minogue Adjunct	D.Min. Doctor of Ministry M.Div. Divinity Doctoral Studies, Ethics M.A. Theology B.A. Philosophy/Minor: Mathematics & Physics	BUS 240, BUS 250, BUS 284, BUS 310, BUS 458
Mr. Sam Morgan III Adjunct	M.S. Aerospace, Aeronautical, & Astronautical Engineering B.G.S. General Studies MQ-1 Predator Pilot MQ-9 Reaper Instructor Pilot A-10 Instructor/Evaluator Pilot F-16 Maintenance Officer Military Pilot (T-37, T-38)	ALL UAS Courses
Dr. Mark Moss Adjunct	Ph. D. Computer Science M.S. Computer Science B.S. Mathematics	CS 100, BUS 240, BUS 247, BUS 250, BUS 284, BUS 310, BUS 458
Pamela Opeka Full time	M.Ed. Math B.S. Biology & Chemistry	MA 112, MA 114, MA 128, MA 261
Dr. Alexander Perry Adjunct	D.Sc. Cyber Security M.S. Computational Mathematics	BUS 240, BUS 250, BUS 310
Dr. Jason Pittman Full time	Ph.D. Information Assurance M.S. Network Security B.S. English Literature and Micro-Biology	BUS 250, BUS 247, BUS 310, BUS 443, BUS 458
Dr. Gale Pomper Adjunct	D.Sc. Cyber Security M.S. Network Security	BUS 114, BUS 240, BUS 250, BUS 247, BUS 284, BUS 310, BUS 458
Jeffrey Pullen Adjunct	M.B.A. M.S. Public Administration M.S. Accounting M.S. Information Systems B.S. Business Management PMP FAC-P/PM, Senior Level FAC-COR, Level III, Contract Officer Rep	BUS 200, BUS 270, BUS 271, BUS 301, BUS 410, BUS 375, BUS 458
Claude Rankin Full time	M.A. Communication Arts B.A. Political Science & Speech Communication/Broadcasting	BUS 200, BUS 358

Dr. Eric Sabbah Full time	Ph.D., Computer Science M.S., Computer Science B.S., Mathematics and Computer Science	CT 130, CT 406, SE 458
Nathan Weideman Adjunct	M.S. Astronautical Engineering B.S. Professional Aeronautics	PH 201, PH 202
Doris Wooding Adjunct	M.ET. Educational Technology M.S. Software Engineering B.A. Anthropology	CT 150

Additional doctorally-qualified faculty will be added in the near future.

ADDITIONAL JUSTIFICATION:
Capitol Technology University's UAS Instructors are leading experts in the UAS and aviation fields:

1. Dr. Richard (Dick) Baker has served as the Chair and a member of Indiana State University's Department of Aviation Technology. The Director of Indiana State University's Center for Unmanned Systems and Human Capital Development, Baker holds a bachelor's degree in Mathematics and master's degree in Computer Science from Indiana State University. He received his doctorate in Information Systems from Nova Southeastern University. Baker has been instrumental in the successful launch of ISU's Center for Unmanned Systems and directs the research and collaboration efforts with strategic partners. Baker brings many years of executive level experience in Information Technology (IT) from companies such as General Motors and Electronic Data Systems (EDS). Prior to entering the academic world, he also had extensive experience in the Aviation industry. Baker served as the Director of Human Factors and Safety for American Airlines where his responsibilities included CRM and safety training for all pilots and flight attendants. He received professional certification in Risk Management from the Transportation Safety Institute. Baker retired as a Colonel from the Indiana National Guard in 2003 where he held command positions including Indiana State Director of Operations, Indiana State Director of Support, 181st Fight Wing Support Group Commander, 181st Mission Support Squadron Commander, and 181st Chief of Supply. During his tenure with the Air Guard, he was a Weapons Systems Officer in the F-4 and worked extensively with airspace issues, rapid response teams for counter-terrorism, the Counterdrug Operations at United States Joint Forces Command, and was a trainer for the Air National Guard's Domestic Preparedness Operations.

2. Mr. Sam Morgan III has served as the Director of Unmanned Systems and an Aviation Instructor at Indiana State University. Mr. Morgan has over 26 years of experience in aviation and unmanned systems. During his 24 years as a pilot in the United States Air Force, Mr. Morgan served as an A-10 Instructor/Evaluator Pilot, MQ-9 Reaper Instructor Pilot, MQ-1 Predator Pilot, F-16 Maintenance Officer, T-37/T-38 Pilot, Fight Safety Officer, Functional Check Flight Pilot, A-10 IP Flight Commander, Command Post Chief, Emergency Actions Controller, Airborne Jump-certified Battalion Air Liaison Officer, and Air Force ROTC Detachment Commander. He retired from active duty as a Colonel in the U.S. Air Force. Following his retirement from active duty, Mr. Morgan continued his work in aviation and unmanned systems as an instructor at Indiana State University.

J. Adequacy of library resources (as outlined in COMAR 13B.02.03.12):

1. **Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within institutional resources, include a supportive statement by the President for library resources to meet the program's needs.**

   Library Services: The Puente Library offers extensive services and a wide collection for Capitol students to be academically successful. Library resources are available digitally. The library also provides a mailing service for materials borrowed through the Maryland system. The library is currently supporting the following degrees at the graduate level: M.S. in Computer Science, M.S. in Cyber and Information Security, M.S. in Electrical Engineering, M.S. in Information Systems Management, M.S. in Internet Engineering, M.B.A., D.Sc. in Cybersecurity, and Ph.D. in Management and Business Analytics. Therefore, the library is fully prepared to support a B.S. in Unmanned and Autonomous Systems.

   Services provided to on line students include:

   - "Ask the Librarian"
   - Research Guides
   - Tutorials
   - Videos
   - Online borrowing

   Capitol Technology University's online library as well as the on-campus library provides faculty and students with reference documents as well as texts appropriate to their learning experiences. Information about those services may be found at: https://www.captechu.edu/current-students/undergraduate/library.

   The John G. and Beverley A. Puente Library provides access to management, decision science, and research methods materials through its 10,000-title book collection, e-books, and its 90 journal subscriptions. The library will continue to purchase new and additional materials in the management, decision science, and research methods area to maintain a strong and current collection in this subject area. Students can also access materials through the library's participation in the Maryland Digital Library Program (MDL). This online electronic service provides access to numerous databases (Access Science, NetLibrary) that will provide access to the materials needed. Available databases include ProQuest, EBSCO, ACM, Lexis Nexis, Taylor Francis, and Sage Publications.

   The Puente Library can provide access to historical management and decision science materials through its membership in the Maryland Independent College and University Association (MICUA) and the American Society of Engineering Education (ASEE). Reciprocal loan agreements with fellow members of these organizations provide the library access to numerous research facilities that house and maintain archives of management and data science documents. The proximity of the University of Maryland, College Park and other local area research and academic libraries provides the Puente Library with quick access to these materials as well.

   The library currently supports the needs students at the undergraduate, masters and doctoral level.

K. Adequacy of physical facilities, infrastructure and instructional equipment (as outlined in COMAR 13B.02.03.13):

1. **Provide an assurance that the 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. If the program is to be implemented within existing institutional resources, include a supportive statement by the President regarding adequate equipment and facilities to meet the program's needs.**

   The program will require a new lab to support the B.S. in Unmanned and Autonomous Systems degree. The university has dedicated the funds to build the new lab that will be constructed during the Summer of 2018 within an existing building on campus. The university has sufficient classrooms to accommodate all hybrid or traditional classroom courses. The online class platform is web based and requires no additional equipment for the institution. The current Learning Management System meets the needs of the degree program. The Computer Science and Robotics Lab, Business and Technology Lab and the Cyber Lab together also meet the potential research needs of the students providing local and virtual support.

L. Adequacy of financial resources with documentation (as outlined in COMAR 13B.02.03.14):

1. **Complete Table 1: Resources. Finance data for the first five years of the program implementation are to be entered. Figures should be presented for five years and then totaled by category for each year.**

TABLE 1: RESOURCES

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	$0	$0	$0	$0	$0
2. Tuition/Fee Revenue (c + g below)	$786,570	$2,411,224	$4,728,575	$5,386,445	$5,605,003
a. Number of F/T Students	25	76	140	141	132
b. Annual Tuition/Fee Rate	$25,619	$26,003	$26,393	$26,789	$27,191
c. Total F/T Revenue (a x b)	$640,475	$1,976,250	$3,695,067	$3,777,282	$3,589,222
d. Number of P/T Students	15	44	103	158	195
e. Credit Hour Rate	$812	$824	$836	$849	$861
f. Annual Credit Hour Rate	12	12	12	12	12
g. Total P/T Revenue (d x e x f)	$146,095	$434,974	$1,033,508	$1,609,162	$2,015,782

3. Grants, Contracts & Other External Sources	$0.00	$0.00	$0.00	$0.00	$0.00
4. Other Sources	-$216,178	-$667,402	-$1,248,536	-$1,276,992	-$1,214,047
TOTAL (Add 1 – 4)	**$570,393**	**$1,743,822**	**$3,480,039**	**$4,109,452**	**$4,390,956**

This proposal builds upon an existing degree programs. All courses exist within the other degree programs currently offered by the university.

2. **Provide a narrative rationale for each of the resource categories. If resources have been or will be reallocated to support the proposed program, briefly discuss those funds.**

a. Reallocated Funds

Capitol Technology University has reallocated funds during Year 1 for support of program and course development, online support, office materials, travel, professional development, and initial marketing. There is no substantial impact on the institution because of the reallocation of these funds. The reallocated funds will be recovered after the first year. The program is expected to be self-sustaining post Year 1.

b. Tuition and Fee Revenue

Tuition is calculated to include an annual 2.5% tuition increase. A 20% attrition rate has been calculated.

c. Grants

There are currently no grants etc. at this time.

d. Other Sources of Funds

There Funds listed are anticipated scholarships for students from outside sources.

3. **Table 2: Expenditure. Finance data for the first five years of the program implementation are to be entered. Figures should be presented for five years and then totaled by category for each year.**

TABLE 2: EXPENDITURES
Courses are taught by adjunct professors.

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)	$225,867	$677,600	$823,284	$1,013,012	$1,107,876
a. # FTE	2.7	8.0	9.7	12.0	13.1
b. Total Salary	$186,667	$560,000	$680,400	$837,200	$915,600
c. Total Benefits	$39,200	$117,600	$142,884	$175,812	$192,276
2. Admin. Staff (b + c below)	$4,659	$4,798	$4,942	$5,090	$5,243
a. # FTE	0.07	0.07	0.07	0.07	0.07
b. Total Salary	$3,850	$3,966	$4,084	$4,207	$4,333
c. Total Benefits	$809	$833	$858	$883	$910
3. Support Staff (b + c below)	$57,475	$114,950	$172,425	$229,900	$287,375
a. # FTE	1.00	2.00	3.00	4.00	5.00
b. Total Salary	$47,500	$95,000	$142,500	$190,000	$237,500
c. Total Benefits	$9,975	$19,950	$29,925	$39,900	$49,875
4. Equipment	$3,840	$11,520	$22,745	$27,986	$30,607
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$35,400	$0	$0	$0	$0
7. Other Expenses	$100,000	$75,000	$50,000	$50,000	$50,000
TOTAL (Add 1 – 7)	**$427,240**	**$883,868**	**$1,073,396**	**$1,325,989**	**$1,481,101**

4. **Provide a narrative rationale for each of the resource categories. If resources have been or will be reallocated to support the proposed program, briefly discuss those funds.**

a. Faculty

Table 2 reflects the faculty hours in total, but this does not imply that these are new hire requirements.

b. Administrative Staff

Capitol Technology University will continue with current the administrative staff through the proposed time period.

c. Support Staff

Capitol with continue with current administrative staff through year two. Additional support staff will be added in year 3.

d. Equipment

Software for courses is available free to students or is freeware. Additional licenses for the LMS will be purchased by the university at the rate of $40 per student. No additional equipment is needed.

e. Library

Money has been allocated for additional materials to be added to the on campus and virtual libraries to ensure currency of literature. It has, however, been determined that the current material serves the needs of this degree due to the extensive online database.

5. **New or Renovated Space**

   No new or renovated space is needed.

6. **Other Expenses**

   Funds have been allocated for office materials, travel, professional development, course development, initial marketing, additional scholarships.

M. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15):

The assessment process at the university consists of a series of events throughout the Academic Year. The results of each event are gathered by the University Assessment Team and stored in Canvas for analysis and use in annual reports, assessments, etc. The University Assessment Team analyzes the results, develops any necessary action plans, and monitors implementation of the action plans.

Academic Year Assessment Events:

Fall Semester:

- Faculty submit performance plans consistent with the mission and goals of the university and department. The document is reviewed and approved with the academic dean.
- Department Chairs and University Academic Dean review the Graduating Student Survey data.
- Department Chairs and University Academic Dean review student internship evaluations.
- Department Chairs and University Academic Dean review grade distribution reports from the spring and summer semesters.
- Department Chairs and University Academic Dean review student course evaluations from the

summer semester.

- Departments conduct Industrial Advisory Board meetings to review academic curriculum recommendations. The Advisory Board meets to begin curriculum review or address special issues that may arise related to curriculum. Based on an analysis and evaluation of the results, the University Academic Dean, faculty and the advisory boards will develop the most effective strategy to move the changes forward.

  NOTE: A complete curriculum review for degrees in the Department of Engineering occurs every 2 years. In most cases, the changes only require that the University Academic Dean inform the CAO and provide a report that includes a justification and the impact of the changes as well as a strategic plan. Significant changes normally require the approval of the CAO and the Executive Council.

- University Academic Dean and Vice President for Academic Affairs attend the Student Town Hall and review student feedback with department chairs.
- Post-residency, the University Academic Dean meets with the faculty to review the student learning progress and discuss needed changes.
- At the August Faculty Retreat, the faculty reviews any outstanding student learning challenges that have not been addressed. The issues are brought to the University Academic Dean for review and development of implementation plans.

Spring Semester:

- Faculty Performance Plans are reviewed with faculty to identify issues of divergence and to adjust the plan as needed.
- Department Chairs and University Academic Dean review grade distribution reports from the fall semester.
- Department Chairs and University Academic Dean review the Graduating Student Survey data.
- Department Chairs and University Academic Dean review student course evaluations from the fall semester and the spring semester (in May before the summer semester begins).
- Department Chairs and University Academic Dean meet to review the content of the graduating student, alumni, and course surveys to ensure the surveys continue to meet the university's assessment needs.
- At Annual Faculty Summit in May, the faculty review and discuss student learning challenges from the past academic year and provide recommendations to the Academic Dean for review and development of implementation plans.
- Department Chairs conduct interviews with potential employers at our Career Fair (this will move to fall and spring in 2016-2017).
- Departments conduct Industrial Advisory Board meetings to review academic curriculum recommendations.

Based on the foregoing inputs from faculty, students, industry representatives and Department Chairs, the University Academic Dean prepares the proposed academic budget for the upcoming year. Budget increases are tied to intended student learning improvements and key strategic initiatives.
In addition to these summative assessments, the University Academic Dean meets with the Department Chairs weekly to review current student progress. This formative assessment allows for immediate minor changes, which increase faculty effectiveness and, ultimately, student outcomes.

The Faculty Senate meets monthly during August through April. The Faculty Senate addresses issues that impact student outcomes as those issues emerge. The leadership of the Faculty Senate then provides a

report on the matter to the University Academic Dean. The report may include a recommendation or a request to move forward with a committee to further examine the issue. In most cases, the changes only require the University Academic Dean to inform the CAO and provide a report that includes a justification and the impact of changes as well as a strategic plan. Significant changes normally require the approval of the CAO and the Executive Council.

Student Learning Outcomes:

Student learning outcomes are measured using the instruments identified above as well as assigned rubrics/measures (e.g. capstone courses, competency exams/projects) dictated by the accreditation requirements of regional accreditor (Middle States Commission on Higher Education) and our degree specific accrediting body (ATMAE). This program is designed to meet the requirements of ATMAE and will be reviewed for accreditation by ATMAE.

N. Consistency with the State Minority Student Achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Post-Secondary Education):

Capitol Technology University is a majority/minority school. Our programs attract a diverse set of students. Special attention is provided to recruit females into the STEM and multidisciplinary programs such as the B.S. MCIT, M.S. CIT, M.S. ISM, D.Sc., and Ph.D. in Management and Decision Sciences. The same attention will be given to the B.S. in Unmanned and Autonomous Systems.

O. Relationship to low productivity programs identified by the Commission:

This program is not associated with a low productivity program identified by the commission.

P. If proposing a distance education program, please provide evidence of the Principles of Good Practice (as outlined in COMAR 13B.02.03.22C):

a. Curriculum and Instruction

Some courses in this concentration will be offered in an online classroom environment as well as in hybrid (synchronous and traditional classroom).

i. A distance education program shall be established and overseen by qualified faculty.

The Department of Electrical Engineering, where this degree will be sponsored, is staffed by qualified teaching chair and other appropriately credentialed faculty.

Evaluation of courses/programs are done using the same process as all other programs. (Please see Section M of this document.) All Capitol faculty teach in the traditional classroom environment and online. (Please see qualifications in Section I of this document.)

ii. A program's curriculum shall be coherent, cohesive, and comparable in academic rigor to programs offered in traditional instructional formats.

Online programs/courses meet the same accreditation standards, goals, objectives, and outcomes as traditional instruction at the university. The online course development process incorporated the Quality Matters research-based set of standards for quality online course design to ensure academic rigor of the online course is comparable to the traditionally offered course. The dean, chairs, and faculty review curriculum annually. Courses are reviewed at the end of each term of course delivery. This process applies to online and traditional courses. In addition, advisory boards are engaged in the monitoring of course quality to ensure quality standards are met regardless of the delivery platform.

iii. **A program shall result in learning outcomes appropriate to the rigor and breadth of the program.**

Online programs/courses meet the same accreditation standards, goal, objectives, and outcomes as traditional classroom delivery. Learning platforms are chosen to ensure high standards of the technical elements of the course. The dean monitors any course conversion from in-class to online to ensure the online course is academically equivalent to traditionally offered course and that the technology is appropriate to support the expected rigor and breadth of the programs courses.

iv. **A program shall provide for appropriate real-time or delayed interaction between faculty and students.**

The program courses will be delivered in a format using Adobe Connect and the LMS Canvas. This system supports both synchronous and asynchronous interaction between faculty and students. Some of these class may also be in hybrid (online real-time and traditional classroom) format.

v. **Faculty members in appropriate disciplines in collaboration with other institutional personnel shall participate in the design of courses offered through a distance education program.**

Currently employed faculty acts as an internal advisory board for program changes including course and program development. All faculty are selected on domain experience and program-related teaching experience.

When new faculty or outside consults are necessary for the design of courses offered our Human Resources Department initiates a rigorous search and screening process to identify appropriate faculty to design and teach online courses. Again, all faculty are selected on domain experience and program-related teaching experience.

b. **Role and Mission**

i. **A distance education program shall be consistent with the institution's mission.**

Distance education is consistent with the institution's mission. Please refer to Section A (please see page 2) of this proposal.

ii. **Review and approval processes shall ensure the appropriateness of the technology being used to meet the program's objectives**

The dean and department chairs are an integral part of the curriculum approval process. The dean, chairs and faculty are participants in any new institutional technology changes. The dean approves technologies brought into the classroom by faculty to ensure compatibility with existing technology as well as with course and institutional objectives.

c. Faculty Support

i. An institution shall provide for training for faculty who teach with the use of technology in a distance education format, including training and learning management system and pedagogy of distance education.

The Department of Distance Learning and the instructional technology division support the online program needs of faculty and students. These departments and the help desk provide constant and on-going support to the faculty. The Canvas portion of the program is the online learning management system. When a new faculty member is assigned to teach an on-line course, the distance learning department provides formal training for that instructor. New faculty are assigned an experienced faculty mentor to ensure a smooth transition to the online environment as well as to ensure compliance with the institution's online teaching pedagogy. The university believes this provides the highest-level learning experience for students and faculty.

ii. Principles of best practice for teaching in a distance education format shall be developed and maintained by the faculty.

The Distance Learning Department, in conjunction with the dean and an assigned mentor, provide on-going support and instruction on best online practices. Best practices are shared among faculty by the dean and chair as well as through formal events. There are also several texts in the library available to the faculty, which cover distance learning techniques and technology.

iii. An institution shall provide faculty support services specifically related to teaching through a distance education format.

As mentioned previously, the university online platforms offer several avenues to support instructors engaged in online learning. The Director of our Distance Learning Division is highly skilled and trained in faculty development. Several seminars and online tutorials are available to the faculty every year. Mentors are assigned to new faculty. Best practice sharing is facilitated through the dean and chair and through formal meetings.

d. An Institution shall ensure that appropriate learning resources are available to students including appropriate and adequate library services and resources.

Students can receive assistance in using online learning technology via several avenues. Student aides are available to meet with students and provide tutoring support in both subject matter and use of the technology. Tutors are available in live real-time sessions using Adobe Connect or other agreed upon tools. Pre-recorded online tutorials are also available.

In addition to faculty support, on ground and online tutoring services are available to students in a one-on-one environment.

Laboratories (on ground and virtual) are available for use by all students and are staffed by faculty and tutoring staff who provide academic support.

Library services and resources are appropriate and adequate. Please refer to Section J (page 29) of this document and the attached letter from the university president, the library adequately supports the students learning needs.

e. Students and Student Services

i. A distance education program shall 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.

Students are provided support identical to traditional on campus students as the technology is utilized by all our students. Curriculum, course and degree information are available on the university website and via e-mail and mail by request. The expectations as it pertains to the faculty/student interaction are available to students during virtual open house events, literature, website, etc. In addition, this information is part of the material distributed for each course. Students receive guidance on proper behavior/interaction in the online environment to facilitate a high-level learning experience. Computer requirements are listed on our website and are provided to students in the welcome package. Students are provided a list of departmental services and contacts. Students may request special/additional training to include one-on-one training. In addition, training videos are available in Capitol Technology University's student web portal

ii. Enrolled students shall have reasonable and adequate access to the range of student services to support their distance education activities.

Students have access to the same services as traditional on ground students. Some of these services are facilitated via such tools as Skype. For instance, distance students attend job fairs via Skype facilitated by an assigned campus representative. In addition, training videos are available in Capitol Technology University's student web portal.

ii. Accepted students shall have the background, knowledge and technical skills needed to undertake a distance education program.

Students are required to have the same skills as tradition on ground students. Training is available for students to familiarize them with the tools of the distance learning system.

iii. Advertising, recruiting and admissions materials shall clearly and accurately represent the program and services available.

Advertising, recruiting, and admissions materials do clearly and accurately represent the program and the services available.

f. Commitment and Support

i. **Policies for faculty evaluation shall include appropriate considerations of teaching and scholarly activities related to distance education programs.**

All faculty, including online faculty, are strongly encouraged to participate in at least one or two professional development opportunities to improve online teaching skills. Faculty are highly encouraged to share their experiences with fellow faculty as well as through publications and presentations. These factors are considered in the annual goals and objectives of faculty and, therefore, are considered in evaluation of performance for promotions, etc. Scholarly activities are recognized in formal university publications. Funding in the annual budget is provided for conferences in support of scholarly activities. Faculty meetings and colloquiums provide opportunities to share best practices among faculty. This includes online faculty. In addition, all faculty are offered the opportunity to attend the annual graduation ceremony and attend the annual faculty residency training event at the expense of the university.

ii. **An institution shall demonstrate a commitment to ongoing support, both financial and technical, and to continuation of a program for a period sufficient to enable students to complete a degree or certificate.**

The university has made the financial commitment to the program (refer to Section L). The university has a proven track record of supporting degree completion.

g. **Evaluation and Assessment**

i. **An institution shall evaluate a distance education program's educational effectiveness, including assessment of student learning outcomes, student retention, student and faculty satisfaction and cost-effectiveness.**

The university applies the same evaluation standards and processes to all degree programs at the institution. (Please see Section M, page 33, for an in-depth process description.)

In the Department of Electrical Engineering, where this program will be sponsored, evaluations are done at the course level, student level, curriculum level, and faculty level as well as other stakeholder groups.

Assessment is based on the integration of all the above items as appropriate. Changes are developed and implemented by the faculty responsible for the courses upon approval of the dean. At the end of this cycle, an evaluation is repeated and results analyzed with the appropriate stakeholders regarding the effectiveness of the changes. This is an ongoing process. The university has a vice president and team in charge of outcomes and assessment supporting formal assessment measures.

ii. **An institution shall demonstrate an evidence-based approach to best online teaching practices.**

Capitol Technology University has established a course/program matrix, which requires faculty to report student outcomes and suggestions for improving student performance. The university complies with the requirements of its accrediting bodies regarding outcomes/evidenced based accreditation (Middle States Commission on Higher Education, ABET, IACBE, and NSA/DHS). The university is in good standing with all

its accrediting bodies.

iii. An institution shall provide for assessment and documentation of student achievement of learning outcomes in a distance education program.

The assessment for distance learning classes/students is the same as for all programs at the university. Faculty provide required data on student achievement. The Learning Management System provides data on student achievement. Proof of these assessments is available during the class and post class to the VP of Academic Affairs, dean, and department chairs. On an annual basis, the information is reported to accreditation authorities such as Middle States Commission on Higher Education, IACBE, ABET, and NSA/DHS. The same requirement will occur with ATMAE for this program.