

Proposal for a Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT)

EXECUTIVE SUMMARY

This proposal provides for a 2+2 plan for an ABET/ETAC accredited Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT) to be jointly conducted by Casper College, UW at Casper (UW-C), and the UW College of Engineering and Applied Science (CEAS). This degree idea originated between discussions of former UW President Nichols and Casper business leaders. As Casper leaders work to recruit businesses into Casper, they hear about lack of an educated workforce and particularly the lack of upward mobility for existing employees. They identified a lack of a pipeline of employees as an inhibitor to growing the Casper workforce. An applied computer engineering degree stood out as an area that was frequently requested with broad-based employer support.

The UW Department of Electrical and Computer Engineering will offer a quality CET-IIoT program at UW-C with additional resources. This would require the following permanent personnel: two new tenure track faculty positions, one Academic Professional/Professor of Practice, and one state G.A. It is a significant investment, but very small and efficient considering that this investment would create in Casper a very new, highly technical, lab intensive, four year, ABET-accredited program which differs markedly from anything offered at UW.

What is engineering technology? The Software Engineer Insider describes computer engineering technology as... “is about hardware and software systems and about getting them to work together efficiently...Computer engineering technology is more focused on pragmatics than theory. You don’t need as much engineering, and you may not need as much calculus either...What are computer engineering technologists doing on the job? Options include quality assurance, computer integrated manufacturing, technical documentation, and computer repairs. Schools also report that their graduates have been hired as computer systems engineers, computer test engineers, and software engineers. Prospective students should be aware that many engineering positions do favor those with bachelor’s degrees [www.softwareengineerinsider.com].”

What is the Industrial Internet of Things? The proposed Computer Engineering Technology degree will focus on the Industrial Internet of Things (IIoT). “The term IIoT refers to the Industrial Internet of Things. In broad strokes, it’s the application of instrumentation and connected sensors and other devices to machinery and vehicles in the transport, energy and industrial sectors. IIoT is different from other IoT applications in that it focuses on connecting machines and devices in industries such as oil and gas, power utilities and healthcare.”

What is the demand for IIoT related jobs? In October 2019 Indeed.com had postings for 1,320 Industrial IoT positions and entry level 18,204 IoT jobs. Salaries ranged from \$30,000 to \$120,000.

What is the student demand for this degree? We anticipate that this program will generate much interest among potential students. We have identified the following groups:

- Current students at regional community colleges would be a good source of candidates for this program. Casper College has approximately 10-15 AAS graduates per year in related degrees.
- Many students leave the College of Engineering and Applied Science every year due to a number of reasons. Many would like to have a career within an engineering field but for various reasons are not successful in completing their degree. Currently, there is no alternative engineering or computer science paths available at the University of Wyoming.
- CEAS has a strong relationship with the Southern Alberta Institute of Technology. CEAS has a long standing articulation agreement with SAIT concerning the Petroleum Engineering Program. The agreement allows

students completing a Petroleum Engineering Technology (PET) from SAIT to complete a BS in Petroleum Engineering at UW with 2.5 years of additional study. CEAS is working to extend this articulation agreement to other technology programs at SAIT. However, some of the degree programs offered by SAIT do not have a counterpart at UW. The CET-IIOT degree would provide this counterpart program and pathway to a four year degree.

Costs/Benefit Analysis

A summary of program cost and benefits is provided in the Table 3. The analysis shows that the program could become self-supporting by AY24-25 by adding five in state and out of state students per year. Aggressive marketing will start once the program is approved. We are not suggesting a steady state enrollment of 50 in the program but an indicator of the self-supporting benchmark. Academic Affairs committed to a tenure track faculty member in AY19/20. This faculty member has been hired. Academic Affairs committed to a Professor of Practice position for AY20/21.

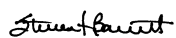
Table. Cost/Benefit Analysis for the Computer Engineering and Information Technology Degree.

New Program Cost Analysis		AY19-20	AY20-21	AY21-22	AY22-23	AY23-24	AY24-25
		soft launch CC		launch at UW-C			
Income							
	Student Census			5	10	20	25
	Resident Tuition and Fees	students at CC	students at CC	\$ 27,000.00	\$ 54,000.00	\$108,000.00	\$135,000.00
	2019 rate \$ 5,400.00						
	Non-resident Tuition and Fees	students at CC	students at CC	5	10	20	25
	2019 rate \$17,490.00			\$ 87,450.00	\$174,900.00	\$349,800.00	\$437,250.00
	Income			\$ 114,450.00	\$ 228,900.00	\$457,800.00	\$ 572,250.00
Expenses							
	Compensation and Benefits						
	TT track faculty	\$150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00
	Teaching Assistant	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00
	Academic Professional/Professor of Practice		\$105,000.00	\$ 105,000.00	\$105,000.00	\$105,000.00	\$105,000.00
	TT track faculty			\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00
	PT/FT admin asst			\$ 20,000.00	\$ 20,000.00	\$ 60,000.00	\$ 60,000.00
	Travel	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00
	Expense	\$179,000.00	\$284,000.00	\$ 454,000.00	\$454,000.00	\$494,000.00	\$494,000.00
Expenses via Fund Raising							
	UW-C Laboratory (fund raising)		\$100,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00
	Marketing (fund raising)	\$ 8,000.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00
	Note: Fund raising items not included in expense above						
	Total program cost	\$187,000.00	\$386,500.00	\$ 459,500.00	\$459,500.00	\$499,500.00	\$499,500.00

Recommendation

Respectfully request approval of the attached proposal for Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT).

Respectfully submitted,



Steven F. Barrett, Ph.D., P.E.
Associate Dean for Academic Programs

Proposal for a Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT)

OVERVIEW

This proposal provides for a 2+2 plan for an ABET/ETAC accredited Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT) to be jointly conducted by Casper College, UW at Casper (UW-C), and the UW College of Engineering and Applied Science (CEAS). In this proposal we discuss what is engineering technology, how is it different than an engineering degree, accreditation processes, job prospects for computer engineering technologists, a proposed 2+2 program, discussion on concept of program operations, program administration, costs of developing a program, program funding, a proposed timeline, possible funding sources, and development timelines.

The UW Department of Electrical and Computer Engineering will offer a quality CET-IIoT program at UW-C with additional resources. This would require the following permanent personnel: two new tenure track faculty positions, one Academic Professional/Professor of Practice, and one state G.A. It is a significant investment, but very small and efficient considering that this investment would create in Casper a very new, highly technical, lab intensive, four year, ABET-accredited program which differs markedly from anything offered at UW. Please find letters of support from the University of Wyoming – Casper and Casper College at **Attachments 1 and 2**.

BACKGROUND

How did the idea for this program get started? On April 22, 2019, former UW President Laurie Nichols addressed the UW Faculty Senate regarding this degree. Provided below is a transcript of her points:

- Where did this degree request come from?
 - Two + year conversation with Charles Walsh, CEO of CAEDA (Casper Area Economic Development Alliance) and their board members.
 - Jarod Stack who now runs the Casper Incubator was also part of these conversations
- As CAEDA works to recruit businesses into Casper (or expand existing businesses/industry), they hear about lack of an educated workforce and particularly the lack of upward mobility for existing employees or ability to recruit employees---at the bachelor's level.
- Lack of a pipeline of employees was an inhibitor to growing the workforce.
- Applied computer engineering degree stood out as an area that was frequently requested with broad-based employer support.
- They wanted the degree offered in Casper, articulated with Casper College AS Degree in computer science or engineering technology.
- This, by the way, is similar to tourism industry that also requested a bachelor's degree in tourism or hospitality management.
- In our role of the sole public 4-year university in Wyoming, we must be responsive to the workforce needs of the state. We need to engage with industry and business, listen to their needs, and to the extent we can, be responsive.
- This is a reciprocal relationship----they depend on us for a workforce supply, and we depend on them for support when we request state funding or private support, or both.
- UW Casper is our only branch campus, and they especially need for us to be responsive to the needs of Casper and region. As a branch campus, they need an element of:
 - Champions to get new programs established.
 - Independence to grow programs, even when those programs are small compared to the overall enrollment on the Laramie campus.

- Understand and serve their audience....place-bound students who have complex lives, but want a college education.

What is engineering technology?

The *Software Engineer Insider* describes computer engineering technology as... “is about hardware and software systems and about getting them to work together efficiently...Computer engineering technology is more focused on pragmatics than theory. You don’t need as much engineering, and you may not need as much calculus either...What are computer engineering technologists doing on the job? Options include quality assurance, computer integrated manufacturing, technical documentation, and computer repairs. Schools also report that their graduates have been hired as computer systems engineers, computer test engineers, and software engineers. Prospective students should be aware that many engineering positions do favor those with bachelor’s degrees [www.softwareengineerinsider.com].”

How is technology different than engineering?

Stephen R. Cheshier provides an excellent overview of engineering technology in his book, “The Field of Engineering Technology.” A figure from his book provides an overview of the relationship between engineering and technology. Cheshier indicates there is not clear demarcation between engineers and technologists but it may be viewed as a spectrum [S.R. Cheshier].

Cheshier further indicates, “Engineering technology draws upon the same body of knowledge as engineering, but centers more heavily upon the applications related to manufacturing, testing, construction, maintenance, field service, and marketing [S.R. Cheshier].”

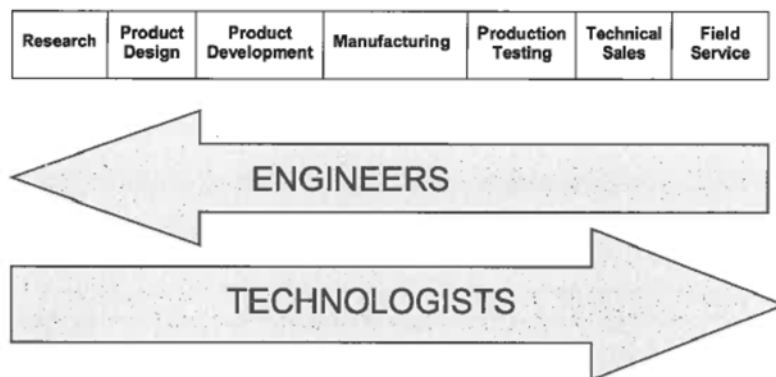


Figure 1. The Technological Spectrum [S.R. Cheshier]

According to Henniger in a 1959 report, the engineering workforce is comprised of three different but related occupations: engineers, engineering technologists, and technicians. The National Academy of Engineering’s (NAE) report “Engineering Technology Education in the United States [Frase, et al, 2016] and “Profession X” [Kaplan-Leiserson, 2017] provide the following definitions:

- “A **technician** is an individual with a two year engineering technology [ET] degree.” “Engineering technicians are the “hands-on” members of the engineering team working **under** engineers, scientists, and technologists.”
- “A **technologist** is an individual with a four year ET degree.” “Engineering technologists are the members of the engineering team who work closely **with** engineers, scientists, and technicians.” “Engineering technology is application and labs and applying it to industry.”
- “An **engineer** possesses a four year engineering degree.” “Engineering is more emphasis on theory and upper-level math.”

Additional background information on engineering technology is provided in **Attachment 3**.

What is the Industrial Internet of Things?

The proposed Computer Engineering Technology degree will focus on the Industrial Internet of Things (IIoT).

- “Everyone’s heard of the IoT – smart thermostats, Internet-connected refrigerators, connected lightbulbs – but there’s a subset called industrial IoT that has a much more significant day-to-day impact on businesses, safety and even lives.”
- “The term IIoT refers to the Industrial Internet of Things. In broad strokes, it’s the application of instrumentation and connected sensors and other devices to machinery and vehicles in the transport, energy and industrial sectors. IIoT is different from other IoT applications in that it focuses on connecting machines and devices in industries such as oil and gas, power utilities and healthcare.”
- “Instrumentation for production lines can let companies track and analyze their processes on an enormously granular level, asset tracking can give a quick, accessible overview of a huge amounts of material, and predictive maintenance can save companies big money by addressing problems before they have a chance to become serious – the number of potential use cases is vast, and growing by the day.”
- The Industrial IoT Consortium lists these 15 possible uses of IIoT:
 - Smart factory warehousing applications
 - Predictive and remote maintenance.
 - Freight, goods and transportation monitoring.
 - Connected logistics.
 - Smart metering and smart grid.
 - Smart city applications.
 - Smart farming and livestock monitoring.
 - Industrial security systems
 - Energy consumption optimization
 - Industrial heating, ventilation and air conditioning
 - Manufacturing equipment monitoring.
 - Asset tracking and smart logistics.
 - Ozone, gas and temperature monitoring in industrial environments.
 - Safety and health (conditions) monitoring of workers.
 - Asset performance management

Source: Excerpts were taken from: <https://www.networkworld.com/article/3243928/internet-of-things/what-is-the-industrial-iiot-and-why-the-stakes-are-so-high.html>

DEGREE DEMAND FROM POTENTIAL EMPLOYERS

What is the demand for IIoT related jobs? In October 2019 Indeed.com had postings for 1,320 Industrial IoT positions and entry level 18,204 IoT jobs. Salaries ranged from \$30,000 to \$120,000.

Gray Associates Program Evaluation System (PES). The University of Wyoming recently purchased Gray Associates Program Evaluation System (PES). As Gray Associates describe the program, it is a system to “select the Best Programs to Start, Stop, Sustain, or Grow. “Gray Associates’ Program Evaluation System (PES) provides your college or university data on student demand, employment, and competition in your markets. PES allows you to make sense of the markets for your programs using custom scoring rubrics and easy to understand visualizations [https://www.grayassociates.com/].”

The system allows queries for all programs in the Integrated Postsecondary Education Data System (IPEDS) [https://nces.ed.gov/ipeds/]. Specific programs are searched via the Classification of Instructional Programs (CIP) code. The current CIP codes in used were updated in 2010. The CIP codes will again be updated in 2020. Draft changes to the code are available for review.

The PES system evaluates a specific selected program in four categories: student demand (41%), employment (36%), competitive intensity (19%), and strategic fit (4%). Within each category, PES uses several different metrics to provide a program numerical rating. The metric weighting may be adjusted by the PES user.

Jayne Pearce (Manager, Outreach Credit Programs, Office of Distance Education Support) and Steven Barrett (Associate Dean for Academic Programs, College of Engineering and Applied Science) performed PES runs for the following programs:

- 15.1201 Computer Engineering Technology
- 11.0101 Computer and Information Sciences
- 15.0303 Electrical/Communications Engineering Technology
- 15.1202 Computer Tech/Computer Systems Technology
- 11.0103 Information Technology

PES runs were accomplished for several markets (Laramie 360 and National) and different delivery methods (ground – resident and online). A summary of results is provided in Table 1. As shown in Table 1 Computer and Information Sciences (11.0101) and Information Technology (11.0103) enjoy strong metrics in student and employer demand and the overall ratings. In contrast, the most closely matching code (Computer Engineering Technology 15.1201) shows far lower scores. Gray and Associates data is based on CIP codes that are updated approximately every ten years. Review of the CIP data for 2010 and projections for 2020 do not incorporate the Industrial Internet of Things. Our hope is that the combination of CET with the rapidly growing IIoT field will have desirable future student and employer demand.

Table 1. Gray Associates Program Evaluation System.

CIP Code	CIP Title		Student Demand	Employ Demand	Fit	Compet Intensity	Overall Score	Student Demand	Employ Demand	Fit	Compet Intensity	Overall Score	Student Demand	Employ Demand	Fit	Compet Intensity	Overall Score	Student Demand	Employ Demand	Fit	Compet Intensity	Overall Score
			Ground Laramie 360					Online Laramie 360					Ground National					Online National				
15.1201	Computer Engineering Technology	Bach	-2	8	0	10	16	-4	8	0	10	14	-2	4	0	10	12	0	5	0	12	17
11.0101	Computer and Information Sciences	Bach	16	20	4	6	46	4	22	4	6	36	25	20	4	7	56	4	22	4	6	36
15.0303	Electrical/Communications Engineering Technology	Bach	-3	12	0	9	18	-3	13	0	11	21	-1	10	0	12	21	0	12	0	11	23
15.1202	Computer Tech/Computer Systems Technology	Bach	-4	8	0	10	14	-2	8	0	10	16	-2	10	0	9	17	1	10	0	14	25
11.0103	Information Technology	Bach	17	19	4	4	44	21	19	4	2	46	20	20	4	7	51	24	20	4	7	55

EAB (formerly Education Advisory Board). To quantify the projected student demand for the degree and also potential job placement, we worked with Jayne Pearce (Mgr, Outreach Credit Programs, Office of Distance Ed Support) and Reed Scull (Assoc Professor, Schl Cnslng Ldrshp Advoc & Des) to request a market study from EAB. “EAB, formerly Education Advisory Board, offers best practice research, technology, and services for leaders of academic affairs, business affairs, student affairs [www.eab.com].” EAB conducted the following two surveys (from Lauren Edmonds, EAB, March 28, 2018):

- “A more holistic exploration: This included research conversations with program directors of offerings similar to the CET degree. Those conversations addressed nuanced questions such as students’ preparedness for calculus entering the program and what support is required for students to succeed. EAB also discussed with directors how they recruit students for the program when it’s difficult to position against existing computer engineering programs. The labor market analysis described below was also included.
- EAB also completed a labor market-focused analysis: this research included the change in demand for CET skills over time to determine if there is an emerging need, the top employers seeking candidates with relevant CET skills, as well as comparison of where else similar programs are against top cities with need for CET graduates. They also included advertised salaries with and without a teaching license. They also profiled other programs’ credentialing options (including alternative credentials available) and their admissions requirements and advertised tuition.
- Results of the EAB survey were received in late June 2018. EAB provided an extensive report titled: “Market Research brief -- Market Demand for a Bachelor’s-Level Program in Computer Engineering Technology--Analysis of Regional and State Employer Demand, Program Characteristics, and Student Trends.” Briefly, the report indicated:
 - Job posting data provided lumped together Computer Science, Computer Engineering, and Computer Engineering Technology.
 - The number of CET graduates nationwide in 2016 was only 434.
 - The total number of CET graduates pursuing an education career is very low.
 - None of the profiled institutions offering CET programs included activities to prepare graduates to become educators.
 - Concerns were expressed that a graduate of the concurrent major would likely pursue a career in Computer Engineering Technology as opposed to education due to the higher salary potential in engineering.

Qualitative demand indicators. There are other indicators the degree program may be popular.

- Many students leave the College of Engineering and Applied Science every year due to a number of reasons. Many would like to have a career within an engineering field but for various reasons are not successful in completing their degree. Currently, there is no alternative engineering or computer science paths available at the University of Wyoming.
- CEAS believes the CET-IIOT degree would have a broad appeal to a number of Wyoming industries and commercial ventures.
- CEAS has a strong relationship with the Southern Alberta Institute of Technology (SAIT) and are beginning discussions with the Northern Alberta Institute of Technology (NAIT). Both institutions provide two year technology degrees. CEAS has a long standing articulation agreement with SAIT concerning the Petroleum Engineering Program. The agreement allows students completing a Petroleum Engineering Technology (PET) from SAIT to complete a BS in Petroleum Engineering at UW with 2.5 years of additional study. CEAS is working to extend this articulation agreement to other technology programs at SAIT and NAIT. However, some of the degree programs offered by SAIT and NAIT do not have a counterpart at UW. The CET-IIOT degree would provide this counterpart program and pathway to a four year degree.
- The Economically Needed Diversity Options for Wyoming (ENDOW) Initiative “coordinates and expands ongoing efforts throughout Wyoming, and produces measurable results, in providing a comprehensive approach to diversifying the state’s economy [https://www.endowyo.biz/].” This degree program could provide the technology skill set needed to help move ENDOW initiatives forward.

This degree will be heavily marketed to potential students and employers throughout the Mountain West and Front Range regions.

PROGRAM ACCREDITATION

Engineering and technology programs in the United States are accredited by ABET. “ABET is a nonprofit, non-governmental organization recognized by the Council for Higher Education Accreditation.” Engineering programs are accredited by ABET/EAC while technology programs are accredited by ABET/ETAC [www.abet.org]. Specific guidelines for accrediting technology programs are provided in “Criteria for Accrediting Engineering Technology Programs.” The criteria for accreditation fall into two categories:

- **General Criteria** – General Criteria apply to all programs accredited by an ABET commission. Each program accredited by an ABET commission must satisfy every Criterion that is in the General Criteria for that commission.
- **Program Criteria** – The Program Criteria provide discipline-specific accreditation criteria. Programs must show that they satisfy all of the specific Program Criteria implied by the program title. Any overlapping requirements need be satisfied only once.

A summary of program specific Computer Engineering Technology ABET/ETAC accreditation requirements is provided at **Table 2**.

Table 2: ABET/ETAC Program Criteria.

ABET curricular requirements	Coursework
analog and digital electronics	ELTR 1515 Basic AC/DC Electronics EE 2390 Digital Systems Design CET 3XXX Analog Electronics for Technology EE 3XXX Design Experience with Devices
computer programming, programming languages, software applications	COSC 1010 Intro to Computer Science I COSC 1030 Computer Science I COSC 2030 Computer Science II
computer and network hardware, local area networks, system and network administration, telecom	COSC 4760 Computer Networks ES 4970 Internship
databases	CMAP 1815 Database Applications
electric circuit analysis and design	ELTR 1535 Electrical Power ELTR 1605 Process Control ELTR 2815 Programmable Logic Control ES 2210 Electric Circuit Analysis
the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of computer systems and networks (CET)	MATH 2200 Calculus I MATH 2205 Calculus II COSC 2300 Discrete Structures STAT 2050 Fundamentals of Statistics
microcontrollers (CET)	EE 4390 Microprocessors
operating systems	EE 3XXX Linux and Python Programming
the ability to apply project management techniques to computer systems (CET)	EE 48XX Senior Design I, II
engineering standards to the building, testing, operation, and maintenance of computer systems and associated software systems	EE 48XX Senior Design I, II
analyze, design, and implement computer system hardware and software	EE 48XX Senior Design I, II
design, implementation, maintenance, and security of facilities involved in the processing and transfer of information	EE 48XX Senior Design I, II COSC 4760 Computer Networks Internship

Application of natural sciences and mathematics at or above the level of algebra and trigonometry	PHYS 1210 Engr Physics I BIOL 1010 or CHEM 1020 MATH 2200 Calculus I MATH 2205 Calculus II
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ENGINEERING LICENSURE

It must be emphasized that professional licensure is **not** required to practice as an engineer or engineering technologist. However, certain fields require licensure and also to practice as an engineering consultant requires licensure. Model Law for engineering licensure is developed at the national level by the National Council of Examiners for Engineering and Surveying (NCEES). As NCEES indicates: “Professional licensure protects the public by enforcing standards that restrict practice to qualified individuals who have met specific qualifications in education, work experience, and exams. In the United States, licensure for the engineering and surveying professions is regulated by state [www.ncees.org].”

Most states have similar requirements for licensure:

- Completion of an ABET accredited engineering degree (**or equivalent**);
- Successful completion of the Fundamentals of Engineering (FE) examination;
- Four years of practice as an engineer; and
- Successful completion of a discipline specific professional engineering (PE) examination.

To qualify as an **equivalent** degree for licensure purposes, a program must contain at a minimum [extracted from: NCEES Education Standard as of August 2015]:

- 30 college semester credit hours of higher mathematics and basic sciences.
- 45 college credit hours of engineering science and engineering design.
- 16 college credit hours in a general education component that complements the technical content of the curriculum.

Typically engineering technology degrees fall short in the area of higher mathematics and basic sciences. Engineering technologists who wish to pursue licensure may take additional coursework to meet the requirements of an equivalent degree.

PROPOSED PROGRAM

To develop a proposed program, similar programs were reviewed from the University of Houston, California State University - Long Beach, SUNY Poly, and Purdue – IUPUI. A draft proposed program is provided at **Attachment 4**.

- The proposed program is a 2+2 plan for an ABET accredited Bachelor of Science Degree in Computer Engineering Technology to be jointly conducted by Casper College, UW at Casper, and the UW College of Engineering and Applied Science (CEAS).
- This program uses existing coursework and new course development and draws upon the strengths of each institution.

Attachment 5 provides a concurrent major plan for a Computer Engineering Technology Bachelor of Science degree for the Wyoming Teacher Education Program. This program would be jointly conducted by Casper College, UW at Casper, and the UW College of Education. The Notice of Intent for a BS in Secondary Computer Engineering Technology Education was approved by the Trustees at their January 2018 meeting. Please note that this degree program is housed in the College of Education but builds on content coursework from the College of Engineering and Applied Science. Like all of the other COE secondary degree programs, students get a degree from Education, which makes them eligible for licensure in Wyoming to teach in grades 6-12. In addition, they will receive a concurrent major in Computer Engineering

Technology from CEAS. Other secondary education programs in the COE are built in similar fashion, in partnership with the College of Arts and Sciences and (most recently) the College of Agriculture and Natural Resources.

- The COE is working with CEAS on the content coursework and with the Wyoming Professional Teaching Standards Board (the educator licensing agency in Wyoming) to ensure that we will have eligibility for licensure on this program as well as our others.
- We are following the ITSE Standards for Computer Science Educators to develop this program [www.itse.org/standards]. Reference **Attachment 6**.
- Graduates of the concurrent majors will be equipped to teach beginning computer science courses in Wyoming high schools and also prepare students to be successful on the AP Fundamentals of Computer Science examination. The following exam description is provided by AP Central [<https://apcentral.collegeboard.org>]: “The exam covers fundamentals of object-oriented programming in Java typically taught in a first-semester college course. Both sections of the exam require students to demonstrate their ability to design, write, analyze, and document programs and subprograms. The exam emphasizes programming in Java, programming methodology (including recursion), and procedural abstraction. It also includes algorithms, data structures, and data abstraction. All code on the exam is consistent with the AP Java subset. All questions involving code should be answered in Java. Students are not tested on minor points of syntax.”

If you have questions about approvals, accreditation, or licensure related to this program, please contact Professor Leslie Rush, Associate Dean, UW College of Education (LRush@uwyo.edu). The COE has been working with CEAS on the content coursework and with the Wyoming Professional Teaching Standards Board (the educator licensing agency in Wyoming) to ensure that we will have eligibility for licensure on this program as well as our others.

Concept of Operations

- A student will be able to complete the entire Computer Engineering Technology degree in Casper. We have developed a 2+2 course of study. The first two years may be completed as Casper College while the second two years may be completed at UW at Casper. A 2+2 degree plan is provided at **Attachment 7**.
- Students may complete upper division coursework at UW at Casper or the UW CEAS via Zoom Video. As the program matures at UW at Casper, upper division coursework will be developed and delivered by the faculty at UW at Casper. Students will complete course associated lab requirements at their specific resident locations or via to be developed online laboratory experiences.
- It is essential to hire a faculty member at UW as soon as possible. Ideally, the faculty member will have a broad background in computer engineering, computer science, technology, and considerable industrial experience. Over time the faculty member will develop the upper division coursework to be delivered by UW at Casper and also serve as the CET Program Director. A faculty member was hired in AY 18/19 to fulfil this requirement. Additional faculty will be added as the program matures. CEAS Associate Dean of Academic Programs, Steve Barrett, Ph.D., P.E., serves as the Interim CET Program Director.
- Dean Paul Marquard will serve as the student advisor for the program while students are attending Casper College.
- Details will be worked on a case-by-case basis for other Wyoming Community Colleges participating in this degree program.

ZOOM

ZOOM technology (www.zoom.us) is a cloud based, secure platform for education delivery. UW and UW at Casper already has ZOOM software licenses in place. ZOOM captures instructor delivery in a classical classroom setting, at an instructor’s desk, or any location with cloud access. To configure a classroom for ZOOM use requires additional drop down microphones and cameras. ZOOM configured classrooms are already in place at UW COE and UW at Casper. ZOOM allows interaction between students present in a physical location and those participating virtually. The ZOOM lectures are also captured for later asynchronous viewing [Jeff Miller, Senior Lecturer, UW Office of Distance Education Support].

COST/BENEFIT ANALYSIS

A summary of program cost and benefits is provided in Table 3. The analysis shows that the program could become self-supporting by AY24-25 by adding five in state and out of state students per year. Aggressive marketing will start upon program approval. We are not suggesting a steady state enrollment of 50 in the program but an indicator of the self-supporting benchmark. Academic Affairs committed to a tenure track faculty member in AY19/20. This faculty member has been hired. Academic Affairs committed to a Professor of Practice position for AY20/21.

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	Non-resident Tuition and Fees	students at CC	students at CC	5	10	20	25
	2019 rate \$17,490.00			\$ 87,450.00	\$174,900.00	\$349,800.00	\$437,250.00
	Income			\$ 114,450.00	\$ 228,900.00	\$ 457,800.00	\$ 572,250.00
Expenses							
	Compensation and Benefits						
	TT track faculty	\$150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00
	Teaching Assistant	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00	\$ 24,000.00
	Academic Professional/Professor of Practice		\$105,000.00	\$ 105,000.00	\$105,000.00	\$105,000.00	\$105,000.00
	TT track faculty			\$ 150,000.00	\$150,000.00	\$150,000.00	\$150,000.00
	PT/FT admin asst			\$ 20,000.00	\$ 20,000.00	\$ 60,000.00	\$ 60,000.00
	Travel	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00	\$ 5,000.00
	Expense	\$179,000.00	\$284,000.00	\$ 454,000.00	\$454,000.00	\$494,000.00	\$494,000.00
Expenses via Fund Raising							
	UW-C Laboratory (fund raising)		\$100,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00
	Marketing (fund raising)	\$ 8,000.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00	\$ 2,500.00
	Note: Fund raising items not included in expense above						
Total program cost		\$187,000.00	\$386,500.00	\$ 459,500.00	\$459,500.00	\$499,500.00	\$499,500.00

Several notes on costs:

- A detailed “Resources Needed and Rough Roll-Out Plan for Starting a Computer Engineering Technology Program at Casper, Wyoming” is provided at **Attachment 8 and 9**. Executive Summary: The planned Computer Engineering Technology (CET) degree offering at the University of Wyoming, Casper campus will require that the Electrical and Computer Engineering (ECE) department at the Laramie campus teach a minimum of ten online courses with five online labs, and develop at a minimum an additional six new courses. The department has found many ways to leverage the personnel and facilities in Laramie to offer both the existing ECE degrees plus this new CET degree which differs sharply from our existing programs. Consequently, ECE believes it can offer a quality CET program at UW-C with only moderate resources. This would require the following permanent personnel: Two new tenure track faculty positions, one AP/Professor of Practice, and one state G.A. It is a significant investment, but very small and efficient considering that this investment would create in Casper a very new, highly technical, lab intensive, four year, ABET-accredited program which differs markedly from anything even offered in Laramie.

- Once the program has been running long enough to get a supply of CET senior undergraduates willing and able to take jobs assisting with the lower level labs, they would be hired to provide more onsite help. High level labs would not be appropriate, as senior students teaching other upper division students will be less effective and could cause potential accreditation issues. This will free the AP to offer one more course each year that is tailored specifically for CET majors. Estimated cost equals that of one half state GA, though they would not be graduate students so they wouldn't be eligible for a GA position.
- Monetary funds for laboratory equipment at the Casper campus. Our goal will be to offer as many labs as possible from the outset that are suitable for online, independent work by each student. The UW ECE Department has developed online lab programs for the ES 2210 Electric Circuits course and the EE4390 Microprocessors course. Lab programs for EE2390 Digital Design and EE2220 are in development.
- Monetary funds for travel to and from Casper. Estimated at five visits per year for each of the four permanent personnel above at \$250/trip = \$5000 yearly.
- Office Associate Senior \$60,000 (salary: \$40K, benefits: \$20K). The duties of the office associate will be to coordinate and schedule the program as well as assist the CET Program Director in advising students. This position will start as part time and transition to full time.
- Laboratory facilities to support extensive practical portion of degree. Laboratory bench with supporting test equipment and software (\$15K per lab bench). It is estimated that six benches would be required at a total cost of \$90,000.
 - Dean Pishko (CEAS), Dean Reutzel (COE), Associate Dean Rush (COE), and Associate Dean Barrett (CEAS) met with Mary Garland of the Ellbogen Foundation on February 15, 2018 to discuss CET equipment needs. She encouraged a submission of a Letter of Inquiry to the Ellbogen Foundation for their support of the equipment needs.
- Marketing Budget: \$5,000-\$7,000
 - Marketing efforts: Facebook/Instagram promotion (geo-targeted at Wyoming/Casper students), print materials (to be distributed in high school classrooms/counselor offices across the state), newspaper ads (statewide/Casper), radio spots (statewide/Casper), digital advertising (via Spectrum Communications) – Andy Chapman, Marketing/Communications Specialist, University of Wyoming Institutional Marketing
- The College of Education requires an Academic Professional Lecturer to prepare and deliver the Methods in the Discipline coursework for the degree program.

POTENTIAL SOURCES OF FUNDING

- **BOCES** Regional Grants: “Central Wyoming Board of Cooperative Educational Services (BOCES) exists to provide the citizens of Natrona County and Central Wyoming quality educational services which can not be provided as effectively or efficiently by the Natrona County Schools or Casper College when provided independently.” “BOCES stands for the Board of Cooperative Educational Services. It began in 1991 as a joint venture between Casper College and the Natrona County School District. Since that time, it has evolved to support several beneficial programs in Natrona County.” “BOCES receives money from Natrona County property taxes. Natrona County School District levies 1/2 mil and Casper College levies 1/2 mil. BOCES receives approximately \$1.2 million annually from property tax levies.” [www.caspercollege.edu/boces]
- **CAEDA**, Charles Walsh, “CAEDA serves as the principal catalyst for economic development through leading, encouraging and facilitating diversification and expansion of Casper’s and Natrona County’s economy. We accomplish this by working with community and state partners. CAEDA continues to work heavily to develop an infrastructure that serves as a foundation for growth from outside and strengthening from within our community. Our focus is job growth through new business recruitment, a business expansion and retention program and a celebration of the spirit of entrepreneurship. Community, Infrastructure and Job Creation are our goals and each is equally important to a growth economy. Fiscal responsibility and communication are our guiding principles. We

recognize that today’s economic development depends on effective communications from outside organizations through the creation of partnerships whose aim is for transparent collaboration.” [http://www.caeda.net/]

- **Breakthrough 307** – Jared Stack, MS, Firehole Technologies. “The vision of Breakthrough 307: Investors is to provide early stage seed capital to high-growth potential companies in Wyoming and the Rocky Mountain West, while producing positive returns for investors.” [http://breakthrough307.com]
- **Ellbogen Foundation** – Spencer Garland of the Ellbogen Foundation has supported similar projects in the past. The Foundation may be supportive of this initiative.
- **TAACCCT Grants** – “The U.S. Department of Labor's Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant program is a major investment to increase the ability of community colleges to address the challenges of today's workforce. Grants are designed to help workers eligible for training under the TAA for Workers program, as well as a broad range of other adults.” [www.doleta.gov/taaccct/]

PROGRAM DEVELOPMENT SCHEDULE

<p>Fall 2017</p> <ul style="list-style-type: none"> ✓ Finalize Computer Engineering Technology proposal ✓ Obtain Provost and AVP Undergraduate Programs approval ✓ Develop three page Notice of Intent for Trustee review/approval per UW Reg 8-2
<p>Spring/Summer 2018</p> <ul style="list-style-type: none"> ✓ Request EAB study to quantify the projected student demand for the degree and also potential job placement. ✓ Analyze results of study. ✓ Conduct CET Team meeting and develop proposal for Academic Affairs.
<p>Fall 2018/Spring2019</p> <ul style="list-style-type: none"> ✓ Send revised proposal back to Faculty Senate for review and approval in Fall 2019. ✓ Contact Ellbogen Foundation for possible laboratory equipment support. ✓ Hire first tenure track faculty ✓ Develop online labs for EE4390 and ES2210.
<p>Fall 2019/Spring 2020 (AY19/20)</p> <ul style="list-style-type: none"> • Send revised proposal back to Faculty Senate for review and approval in Fall 2019. • Submit proposal to Board of Trustees for review. • Letter of Commitment from Provost’s Office with detailed four year budget • President submit Request for Authorization • Provide information sessions on new degree program to Executive Team, Deans and Directors, Faculty Senate, Staff Senate, and ASUW • Meet with Casper Groups to discuss degree (described below): BOCES, CAEDA, Breakthrough 307, TAACCCT Grants • Develop MOU with Casper CC, UW Casper, and CEAS on shared lab facilities • Contact Ellbogen Foundation for possible laboratory equipment support. • Develop 2+2 agreement with SAIT and NAIT Universities • Develop Marketing Plan for soft program launch • Form joint working CET-IIoT Working Group: CEAS ECE, UW C, CC • Develop program fund raising plan with UW Foundation • Hire graduate assistant • Develop online labs for EE2390 and EE2220 • Hire professor of practice
<p>Fall 2020/Spring 2021 (AY20/21)</p> <ul style="list-style-type: none"> • Program launch for Casper CC Freshmen.
<p>Fall 2022/Spring 2022 (AY22/22)</p> <ul style="list-style-type: none"> • Accept transfer students to program UW Casper • Hire second tenure track faculty • Reference detailed ECE plan.
<p>Fall 2022/Spring 2022 (AY22/23)</p>

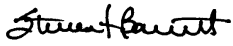
- Reference detailed ECE plan.

A chronological summary of comments on the proposal is provided at **Attachment 10**.

RECOMMENDATION

Respectfully request approval of the attached proposal for Bachelor of Science Degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIoT).

Respectfully submitted,



Steven F. Barrett, Ph.D., P.E.

Associate Dean for Academic Programs

College of Engineering and Applied Science

Attachments:

1. Letter of support – Casper College
2. Letter of support – UW Casper
3. Engineering Technology
4. UW Computer Engineering Technology Degree Program degree check sheet
5. Computer Engineering Technology Bachelor of Science degree for the Wyoming Teacher Education Program
6. ITSE Standards for Computer Science Educators
7. UW Computer Engineering Technology Degree Program – 2+2 degree program flow
8. Resources Needed and Rough Roll-Out Plan for Starting a Computer Engineering Technology Program at Casper, Wyoming
9. Computer Engineering Technology Degree – Course development summary
10. Chronological summary of comments on the proposal

Attachment 1. Letter of Support from Dean Edgens, UW – Casper



October 16, 2018

UW - Casper
125 College Dr., Casper, WY 82601
(307) 268-2713 • (307) 268-2416 (fax)
www.uwyo.edu/outreach/uwcasper

Dr. Steven Barrett
Associate Dean for Academic Programs
College of Engineering and Applied Science

This letter is in support of the Computer Engineering Technology degree to begin 2020 at the University of Wyoming at Casper.

The proposed CET degree follows the UW at Casper Strategic Plan for workforce programs that are unique and only available in Casper. We anticipate building the program on top of Casper College curriculum that serves as a pipeline for the CET degree program. This CET proposal advances the close collaboration between UW and Casper College and resembles the current collaboration between the two institutions in our nationally accredited Medical Lab Sciences program.


Further, this degree serves as a replacement and advancement of the, taught out Technical Education program formerly offered at UWC and provides an opportunity to expand central Wyoming's workforce. We anticipate that additional investment into Casper College's engineering laboratory space will augment both institutions and serve to make this a valuable compliment to the state.

The Board of Cooperative Educational Services (BOCES) is also very interested in how they can support the program along with CAEDA in Casper. To have the support of these two organizations further demonstrates the wider participation and need for the state. This is also consistent with ENDOW's objectives.

UW at Casper has the facilities that support the program for faculty offices and the shared Casper College technical engineering lab space.

Thank you for allowing us to support this endeavor in Casper.

Respectfully,



Jefferson G. Edgens, Ph.D.
Dean
University of Wyoming at Casper

KBK

Attachment 2. Letter of Support, Casper College



Paul Marquard
Instructor, Engineering & Physics
marquard@caspercollege.edu
(307) 268-2250
October 18, 2018

To Whom It May Concern:

I am writing this letter to support the Computer Engineering Technology program at the University of Wyoming – Casper. I have been included in the discussions concerning this program for the last year and I see the addition of this program having an immediate benefit to the students at the University of Wyoming and at Casper College. This partnership will strengthen existing programs at both institutions and will open up options not currently available to students from around the state and region. I have already had interest from current students at Casper College as they will be able to complete a Bachelor's degree without needing to leave Casper; and that is quite appealing to them.

The engineering program at Casper College is eager to make this program successful. Current classes will feed nicely into the program and will lay a strong foundation for students to complete the entire program in a timely fashion. Please accept our enthusiastic support for the Computer Engineering Technology program under consideration. We are eager to make it a reality!

If you have any questions, please do not hesitate to contact me.

Sincerely,

Paul Marquard

Attachment 3: Background on Engineering Technology

The NAE completed an extensive report (cited above) in 2016 about the past, present, and future of Engineering Technology Education. Highlights of the study were also reported by the National Society of Professional Engineers (NSPE) in the October 2017 issue of “PE – the Magazine for Professional Engineers” in an article titled “Profession X.” Provided below are extracts from the report and magazine article that provide more insight into the engineering technology field.

- “The vitality of the innovation economy in the United States depends on the availability of a highly educated technical workforce. A key component of this workforce consists of engineers, engineering technicians, and engineering technologists.”
- “Engineering technology (ET) is unfamiliar to most Americans and goes unmentioned in most policy discussions about the US technical workforce.”
- “Compared with engineering, the history of ET education suggests a greater emphasis on hands-on laboratory experiences and less emphasis on advanced mathematics.”
- “About 80% of ET students came from engineering programs...They find out they like the applied hands-on and maybe not so much the higher level math...If we were not here, they would either leave or transfer to another college.” “Without this option [ET], students who find they’re not suited for more theoretical engineering programs may drop out of the technical workforce entirely.”
- “Engineering technologists help close the gap between engineers and technicians.”
- “In 2014, there were 17,915 graduates with 4-year ET degrees and 34,638 graduates with 2-year ET degrees in the United States.” “In 2013, the total stock of those with 4-year ET degrees was estimated to be about 480,000, and the stock of those with 4-year degrees in engineering was a little over 5 million.”
- “Another strength of engineering technology programs: diversity. The Academy [NAE] study found that compared with engineering programs, ET education programs – especially at the two-year level – are more attractive both to older students and underrepresented minorities.”
- “The relatively small salary premium for technologists, as compared with technicians, may be reducing incentives for entry into 4-year ET programs as well as tamping down overall interest in technologist jobs.” “Although salary growth for both for both types of workers (technicians and technologists) has been flat over the past 40 years (remaining at an average of about \$50,000 annually, in 2015 dollars), average real wages for engineers have risen 23 percent, from \$70,000 to \$86,000 annually.”
- “Engineering technologists and technicians comprise an important, if overlooked, segment of the nation’s STEM workforce.”
- “Largely absent from most discussions of the future of the United States’ technical workforce, however, is the role that engineering technology (ET) education plays or should play in supporting the nation’s technical infrastructure and capacity for innovation.”
- There are 38 institutions in the US that awarded 100 or more 4-year degrees in Engineering Technology in 2014. The includes Purdue University, Texas A&M, Rochester Institute of Technology, University of Houston, Michigan State University, and Colorado State University.
- “According to ABET, in 2014 there were 387 accredited 4-year ET programs at 153 institutions.”
- “Either internships or co-op experiences are a fundamental component of many engineering and ET programs.” “The primary values of the internship to the student (besides the pay) are the on-the-job experience and the potential for converting to an employee after graduation.”

Attachment 4: UW Computer Engineering Technology Degree Program

**Computer Engineering Technology Degree Check
for AY 2018-present - DRAFT**

Jointly conducted degree Casper College/UW at Casper/UW College of Engineering and Applied Science

(USP 2015 - for students entering UW Fall 2015 or later)

STUDENT		CC: onsite	UW: online	EXP GRAD DATE:	
STUDENT ID:		UWC: onsite		ADVISOR:	
GENERAL		Hrs	Grade	Remarks	UD Hrs
MATH & SCIENCE					
Q	MATH	2200	Calculus I	4	CC
	MATH	2205	Calculus II	4	CC
	COSC	2300	Discrete Structures	3	CC
					MATH 2200 or COSC 2300
PN	PHYS	1210	Eng. Physics I	4	CC
	SCI	ELEC	BIOL 1010 or CHEM 1020	4	CC
	STAT	2050	Fundamentals of Statistics	4	CC
					MATH 1400
				23	Note: NCEES requires 32 hours of math and science (MATH 2200 and above) to take the Fundamentals of Engineering Examination. Non-calculus based physics (1110 and 1120) will not count toward the 32 hour total. (MATH 2250, CHEM
UNIVERSITY STUDIES (COM, FYS, H, V)					
		<i>Must be from approved 2015 USP Listing</i>			
COM1	ENGL	1010	English Composition	3	Communication I CC
COM2				3	Communication II CC
COM3	EE	48XX	Senior Design I, II		(see below) UW
FYS*	ES	1000	Orientation to Engineering	1	Freshman Year Semina CC
H				3	diversity course Human Culture #1 CC
H				3	Human Culture #2 CC
V				3	US/WY Constitution CC
	PEAC	1001	Physical Education	1	CC
			Minimum Required	17	*Students are encouraged to enroll in EE 1010 to meet the FYS requirement.
Electrical and Electronics Fundamentals					
	ELTR	1515	Basic AC/DC Electronics	3	CC
	ELTR	1535	Electrical Power	3	CC: ELTR 1570 CC
	ELTR	1605	Process Control	3	CC: ELTR 1515 or ELTR 1570 CC
	ELTR	2815	Programmable Logic Control	4	CC: ELTR 1515 or ELTR 1570 CC
	ES	2210	Electric Circuit Analysis	3	MATH 2200 CC
	EE	2390	Digital Syst. Design	4	MATH 2205 UW
	CET 3XXX	Analog Elect for Tech		4	New course UWC 4
	EE	4390	Microprocessors	3	EE 2390 UW 3
	EE 3XXX	Design Exp with Devices		4	New course UW 4
	COSC	4760	Computer Networks	3	UW 3
	EE	48XX	Senior Design I ***	3	Team with EE4820/4830 UWC 3
COM3	EE	48XX	Senior Design II ***	3	Team with EE4820/4830 UWC 3
			Minimum Required	40	***COM2 course must be taken before EE 4820, and EE 4820 and EE 4830 must be taken in sequence.
Software Fundamentals					
	COSC	1010	Intro to Comp Science I	4	MATH 1400 CC
	COSC	1030	Computer Science I	4	MATH 1405 or MATH 1450 CC
	COSC	2030	Computer Science II	4	COSC 1030 CC
	EE 3XXX	Linux & Python Programming		3	New course UW 3
	COSC	3050	Ethics for the Computer Profession	1	COSC 2030. OL/UWC 1
			Minimum Required	16	
			Required coursework total	96	
ELECTIVE COURSEWORK:				24	24 hours of elective coursework/18 hours of upper division 18
Education track: See CET-ED tab					
Sales track: ACCT1010(3), FIN3250(3), MKT3210(3), MKT4210(3), TBD sales course (9)					
Business track: ACCT1010(3) 1020(3), MGT1040(3), 3110(3), 3210(3), MKT3210(3)					
Organizational leadership: AGRI3000(3), AGRI4600(3), AGRI43560(3), Organizational Leadership (12)					
Technology: Other ELTR or ROBO coursework at Casper College					
Internship/Co-Op: ES4970					
UD Electives: EE4xxx - IOI, EE4xxx - Comp Vision and AI, EE4xxx - Network Programming, COSC 3020, other COSC elect					
			TOTAL HOURS =	120	UPPER DIVISION HOURS = 42
Must have ≥42 hours of upper division credit at ≥3000 level					
Student Signature		Advisor approval		date	
Department approval		College approval		date	

rev: 10/11/2018

Attachment 5. Computer Engineering Technology Bachelor of Science degree for the Wyoming Teacher Education Program

**Computer Engineering Technology Degree Check
for AY 2018-present - DRAFT**

Jointly conducted degree Casper College/UW at Casper/UW College of Engineering and Applied Science

(USP 2015 - for students entering UW Fall 2015 or later)

STUDENT		CC: onsite	UW: online	EXP GRAD DATE:	
STUDENT ID:		UWC: onsite		ADVISOR:	
GENERAL		Hrs	Grade	Remarks	UD Hrs
MATH & SCIENCE					
Q	MATH	2200	Calculus I		CC
	MATH	2205	Calculus II	MATH 2200	CC
	COSC	2300	Discrete Structures	COSC 1030 or MATH 2200 or COSC 2300	CC
PN	PHYS	1210	Eng. Physics I	MATH 2200 or PHYS 1110	CC
	SCI	ELEC	BIOL 1010 or CHEM 1020		CC
	STAT	2050	Fundamentals of Statistics	MATH 1400	CC
		23		Note: NCEES requires 32 hours of math and science (MATH 2200 and above) to take the Fundamentals of Engineering Examination. Non-calculus based physics (1110 and 1120) will not count toward the 32 hour total. (MATH 2250, CHEM	
UNIVERSITY STUDIES (COM, FYS, H, V)					
<i>Must be from approved 2015 USP Listing</i>					
COM1	ENGL	1010	English Composition		CC
COM2	EDST	3000	Teacher as Practitioner	Communication I	CC
COM3	EE	48XX	Senior Design I, II	Communication II	CC
FYS*	ES	1000	Orientation to Engineering	(see below)	UW
				Communication III	CC
H	EDST	2450	Foundations of Dev and Learn	Freshman Year Semina	CC
H	EDST	2480	Diversity and the Politics	diversity course	CC
				Human Culture #1	CC
V				Human Culture #2	CC
				US/WY Constitution	CC
	PEAC	1001	Physical Education		CC
		Minimum Required	17	<i>*Students are encouraged to enroll in EE 1010 to meet the FYS requirement.</i>	
Electrical and Electronics Fundamentals					
	ELTR	1515	Basic AC/DC Electronics		CC
	ELTR	1535	Electrical Power	CC: ELTR 1570	CC
	ELTR	1605	Process Control	CC: ELTR 1515 or ELTR 1570	CC
	ELTR	2815	Programmable Logic Control	CC: ELTR 1515 or ELTR 1570	CC
	ES	2210	Electric Circuit Analysis	MATH 2200	CC
	EE	2390	Digital Syst. Design	MATH 2205	UW
	CET	3XXX	Analog Elect for Tech	New course	UWC
	EE	4390	Microprocessors	EE 2390	UW
	EE	3XXX	Design Exp with Devices	New course	UW
	COSC	4760	Computer Networks		UW
	EE	48XX	Senior Design I ***	Team with EE4820/4830	UWC
COM3	EE	48XX	Senior Design II ***	Team with EE4820/4830	UWC
		Minimum Required	40	<i>*** COM2 course must be taken before EE 4820, and EE 4820 and EE 4830 must be taken in sequence.</i>	
Software Fundamentals					
	COSC	1010	Intro to Comp Science I	MATH 1400	CC
	COSC	1030	Computer Science I	MATH 1405 or MATH 1450	CC
	COSC	2030	Computer Science II	COSC 1030	CC
	EE	3XXX	Linux & Python Programming	New course	UW
	COSC	3050	Ethics for the Computer Profession	COSC 2030.	OL/UWC
		Minimum Required	16		
		Required coursework total	96		
Educational Track Requirements					
	EDST	3550	Educational Assessment		2
	ITEC	2360	Teaching with Technology		3
	EDEX	2484	Introduction to Special Ed		3
			Methods within Discipline		7
			Student Teaching		12
		Minimum Required	27	UPPER DIVISION HOURS	51
		TOTAL HOURS =	123	Must have ≥42 hours of upper division credit at ≥3000 level	
Student Signature		Advisor approval		date	
Department approval		College approval		date	

rev: 10/11/2018

Attachment 6: ITSE Standards for Computer Science Educators

ISTE STANDARDS FOR COMPUTER SCIENCE EDUCATORS

1. Knowledge of content

Computer science educators demonstrate knowledge of computer science content and model important principles and concepts.

a. Demonstrate knowledge of and proficiency in data representation and abstraction

- i. Effectively use primitive data types
- ii. Demonstrate an understanding of static and dynamic data structures
- iii. Effectively use, manipulate and explain various external data stores: various types (text, images, sound, etc.), various locations (local, server, cloud), etc.
- iv. Effectively use modeling and simulation to solve real-world problems

b. Effectively design, develop, and test algorithms

- i. Using a modern, high-level programming language, construct correctly functioning programs involving simple and structured data types; compound boolean expressions; and sequential, conditional, and iterative control structures
- ii. Design and test algorithms and programming solutions to problems in different contexts (textual, numeric, graphic, etc.) using advanced data structures
- iii. Analyze algorithms by considering complexity, efficiency, aesthetics and correctness
- iv. Demonstrate knowledge of two or more programming paradigms
- v. Effectively use two or more development environments
- vi. Demonstrate knowledge of varied software development models and project management strategies

c. Demonstrate knowledge of digital devices, systems and networks

- i. Demonstrate an understanding of data representation at the machine level
- ii. Demonstrate an understanding of machine-level components and related issues of complexity
- iii. Demonstrate an understanding of operating systems and networking in a structured computer system
- iv. Demonstrate an understanding of the operation of computer networks and mobile computing devices

d. Demonstrate an understanding of the role computer science plays and its impact in the modern world

- i. Demonstrate an understanding of the social, ethical, and legal issues and impacts of computing, and attendant responsibilities of computer scientists and users
- ii. Analyze the contributions of computer science to current and future innovations in sciences, humanities, the arts and commerce



ISTE STANDARDS FOR COMPUTER SCIENCE EDUCATORS

1. Knowledge of content

Computer science educators demonstrate knowledge of computer science content and model important principles and concepts.

a. Demonstrate knowledge of and proficiency in data representation and abstraction

- i. Effectively use primitive data types
- ii. Demonstrate an understanding of static and dynamic data structures
- iii. Effectively use, manipulate and explain various external data stores: various types (text, images, sound, etc.), various locations (local, server, cloud), etc.
- iv. Effectively use modeling and simulation to solve real-world problems

b. Effectively design, develop, and test algorithms

- i. Using a modern, high-level programming language, construct correctly functioning programs involving simple and structured data types; compound boolean expressions; and sequential, conditional, and iterative control structures
- ii. Design and test algorithms and programming solutions to problems in different contexts (textual, numeric, graphic, etc.) using advanced data structures
- iii. Analyze algorithms by considering complexity, efficiency, aesthetics and correctness
- iv. Demonstrate knowledge of two or more programming paradigms
- v. Effectively use two or more development environments
- vi. Demonstrate knowledge of varied software development models and project management strategies

c. Demonstrate knowledge of digital devices, systems and networks

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d. Demonstrate an understanding of the role computer science plays and its impact in the modern world

- i. Demonstrate an understanding of the social, ethical, and legal issues and impacts of computing, and attendant responsibilities of computer scientists and users
- ii. Analyze the contributions of computer science to current and future innovations in sciences, humanities, the arts and commerce



Program Computer Engineering Technology



Casper College

FRESHMAN YEAR

Fall Semester				Spring Semester				
			Hrs				Hrs	
COSC	1010	Introduction to Computer Science I	4	COSC	1030	Computer Science I	4	
ES	1000	Orientation to Engineering Study	1	MATH	2205	Calculus II	4	
ENGL	1010	College Composition & Rhetoric	3	PHYS	1210	Engineering Physics I	4	
MATH	2200	Calculus I	4	POLS	1000	US and Wyo Government	3	
ELTR	1515	Basic AC/DC Electronics	3	ELTR	1535	Electrical Power	3	
PEAC	1001	Physical Education Activity	1					
TOTAL				16	TOTAL			

SOPHOMORE YEAR

Fall Semester				Spring Semester				
			Hrs				Hrs	
STAT	2050	Fundamentals of Statistics	4	ENGL	2005	Technical Writing (or Comp 2)	3	
COSC	2030	Computer Science II	4	GenEd		Human Behavior	3	
COSC	2300	Discrete Structures	3	SCI	ELEC	LIFE 1010 or CHEM 1020	4	
ELTR	2815	Programmable Logic Controllers	4	ELTR	1605	Process Control	3	
ES	2210	Electric Circuit Analysis	3	GenEd		Cultural Environment	3	
TOTAL				18	TOTAL			

TOTAL CASPER AA DEGREE HOURS 68

Successful completion of the 2+2 plan requires that a student remain continuously enrolled and graduate with the associate's degree from his or her respective community college. • This is a guide for course work in the major; actual course sequence may vary by student. Please refer to the online student degree evaluation. • Not all courses are offered every semester and some electives may have prerequisites. Students should review the course descriptions in the catalogs of their respective institutions and consult with their academic advisor to plan accordingly. • Academic plans and course schedules may need to be altered if ACT or Math Placement scores require a student to take pre-college courses (e.g., MATH 0900, 0921, or 0925) before taking required math or English courses.

Casper College requirements:

In order to graduate, students must successfully complete a minimum of 60 approved credit hours, with 15 of the last 30 semester hours completed as a degree-seeking student at Casper College, and with a grade point average of 2.0 or higher in those courses counted toward graduation. • Students must earn at least 24 of the semester credits applied toward graduation through the completion of Casper College coursework, including at least six (6) hours with the desired major. • Only courses numbered 1000 or above can be used toward the degree.

University of Wyoming requirements:

Students must have a minimum cumulative GPA of 2.0 to graduate. • Students must complete 42 hours of upper division (3000-level or above) coursework, 30 of which must be from the University of Wyoming. • Courses must be taken for a letter grade unless offered only for S/U.

Transfer Recommendations and Program Notes on page 2.

Computer Engineering Technology Program



University of Wyoming

JUNIOR YEAR

Fall Semester				Hrs	Spring Semester				Hrs
EE	2390	Digital Systems Design	4	EE	4390	Microprocessors	3		
CET	3XXX	Analog Electronics for Technology	4	EE	3XXX	Design Experience with Devices	4		
EE	3XXX	Linux & Python Programming	3			Electives	3		
		Electives	3	COSC	4760	Computer Networks	3		
COSC	3050	Ethics for the Computer Professional	1						
TOTAL				15	TOTAL				13

SENIOR YEAR

Fall Semester				Hrs	Spring Semester				Hrs
EET	4820	Senior Design I	3	EET	4830	Senior Design II	3		
		Electives	9			Electives	9		
TOTAL				12	TOTAL				12
					TOTAL UW HOURS				52
					TOTAL UW BS DEGREE HOURS				120

UW Program Notes:

Education track: See CET-ED degree plan 14

Sales track: ACCT1010(3), FIN3250(3), MKT3210(3), MKT4210(3), TBD sales course (9)

Business track: ACCT1010(3) 1020(3), MGT1040(3), 3110(3), 3210(3), MKT3210(3)

Organizational leadership: AGRI3000(3), AGRI4600(3), AGRI43560(3), Organizational Leadership (12)

Technology: Other ELTR or ROBO coursework at Casper College

Internship/Co-Op: ES4970 UD Electives: EE4xxx - IOT, EE4xxx - Comp Vision and AI, EE4xxx - Network

Programming, COSC 3020, other COSC elect

org. 15/16

Attachment 8:

Resources Needed and Rough Roll-Out Plan for Starting a Computer Engineering Technology Program at Casper, Wyoming

John E. McInroy, Professor and Head

The planned Computer Engineering Technology (CET) degree offering at the University of Wyoming, Casper campus will require that the Electrical and Computer Engineering (ECE) department at the Laramie campus teach a minimum of ten online courses with five online labs, and develop at a minimum an additional six new courses. The department has found many ways to leverage the personnel and facilities in Laramie to offer both the existing ECE degrees plus this new CET degree which differs sharply from our existing programs. Consequently, ECE believes it can offer a quality CET program at UW-C with only moderate resources. This would require the following permanent personnel, which are described in more detail below: **Two new tenure track faculty positions, one AP/Professor of Practice, and one state G.A.** It is a significant investment, but very small and efficient considering that this investment would create in Casper a very new, highly technical, lab intensive, four year, ABET-accredited program which differs markedly from anything even offered in Laramie.

Note that all these resources are needed in addition to the resources currently needed by ECE's existing programs. The largest threat faced by the department is the risk we stand of losing our most outstanding faculty members. Several years of low pay, and long term instability/uncertainty at UW has discouraged many highly productive faculty members. Our most outstanding faculty members are routinely approached by our competitors, and they are now vulnerable. Moreover, three unfilled faculty positions have created a teaching void that has been very difficult to fill already, without offering new programs in remote locales. To help cover this void, the department has been forced to offer its required courses just once per year, which makes for large sections and little flexibility for undergraduates.

In addition, the department has, over the past few years, lost five state G.A.'s. These G.A.'s are vital to the undergraduate program, which is very laboratory intensive. These laboratories have been the hallmark of our undergraduate program, which intensively utilizes active learning. Even without offering the CET program, the department has been considering several options, all of which will inevitably degrade the quality and quantity of our undergraduate laboratories. Historically ECE has had more G.A.'s than other CEAS departments, while other departments have had significantly more expensive research buildings/equipment/ laboratories, shop facilities and staff, etc. When the full cost to the state of these resources and their applicable depreciation and maintenance are accrued to each department, then several additional G.A.'s in ECE are justified, and the inclusion of several new labs for the extremely hands-on CET program will exacerbate this issue.

Details:

1. Two ECE Tenure-Track Positions at the level of Assistant, Associate or Full Professor

The two ECE tenure-track positions will have a Ph.D. in Electrical or Computer Engineering with expertise in the areas of Computer Vision, Robotics, Machine learning, High Performance Computing, or Internet of Things (IoT). The two tenure-track faculty members' primary duties will involve developing new courses and labs in CET, teaching the required and elective CET courses online, assisting Casper-based personnel with the online offerings, and conducting research/economic development in computer engineering. Significant changes will be needed to existing courses to transition both the lectures and the labs to online offerings. Moreover, the CET students will meet the prerequisites for only a few existing ECE courses, so a new suite of courses suitable for both CET and ECE students will be developed. Some courses will also be suitable for Computer Science majors. This will leverage UW resources maximally since a larger number of students will be interested and able to enroll. The new course

topics will be selected from the hottest areas in computers to maximize our graduates' employment potential and Wyoming's economic development. The two tenure-track faculty members will reside at the Laramie campus. Associate or Full Professors are preferred so they have more time to devote to teaching and more experience to help create a program from scratch. During later years of the roll-out, these faculty will develop methods to expand the program across the state and beyond. Allowing the flexibility to hire at any level is important for these positions, as they are anticipated to be hard to fill.

2. One senior level Academic Professional (AP) Position will have at a minimum a Masters in Electrical or Computer Engineering, but a PhD is preferred. This could be a Professor of Practice instead. The primary duties of the AP will be teaching courses and laboratories at the Casper campus, administration at the Casper campus, overseeing internships, and mentorship/advising of the students. Note that due to the rapidly changing nature of computer technology, roughly 25% of the AP's time will be needed for professional and/or economic development to keep pace with the technology.
3. One State supported Graduate Assistant for laboratory teaching
One State GA will be needed to coordinate and help the single AP at the Casper campus to teach multiple sections of the required five online labs and provide on-site repairs and consultation on as needed basis. The GA will teach the labs remotely as the primary point of contact (POC). The AP will be the primary onsite POC. Before the first offerings of each online lab, the GA, in coordination with the two faculty members and the AP, will develop laboratory manuals, software and appropriate hardware for remote lab offerings. It is anticipated that the GA will travel to Casper several times each semester to help address lab problems onsite.
4. Once the program has been running long enough to get a supply of CET senior undergraduates willing and able to take jobs assisting with the lower level labs, they would be hired to provide more onsite help. High level labs would not be appropriate, as senior students teaching other upper division students will be less effective and could cause potential accreditation issues. This will free the AP to offer one more course each year that is tailored specifically for CET majors. Estimated cost equals that of one half state GA, though they would not be graduate students so they wouldn't be eligible for a GA position.
5. Monetary funds for laboratory equipment at the Casper campus. Our goal will be to offer as many labs as possible from the outset that are suitable for online, independent work by each student. This has been done recently by a few ECE departments such as Arizona State University's. UW has no experience with this, and significant equipment and personnel resources will be devoted in the upcoming years towards developing labs which can eventually reach students in even the most remote towns of Wyoming at a reasonable equipment and personnel cost.
6. Monetary funds for travel to and from Casper. Estimated at five visits per year for each of the four permanent personnel above at \$250/trip = \$5000 yearly.

Required Personnel, Timeline, and their Duties During Roll-Out

Personnel	AY19-20	AY20-21	AY21-22	AY22-23	AY23-24
TT#1	Develop online 2390, 3800 labs and courses; teach two new labs and courses in a first trial online format. Travel to Casper and meet/advise new CET students. CET research and economic development.	Teach online 2390 and 3800 courses; oversee their labs. Develop online 4390 course/lab and teach new course in a first online trial. CET research and economic development	Teach 2390, 3800 and 4390 courses, plus one upper division CET course. CET research and economic development.	Teach 2390, 3800 and 4390 courses, plus two upper division EE/CET courses. CET research and economic development.	Teach 2390, 3800 and 4390 courses, plus two upper division EE/CET courses. CET research and economic development.
GA	Test and Develop online 2390, 3800 labs; find online specific hardware, procure and test. Develop necessary software and lab manuals.	Teach 2390, and 3800 labs online. Serve as primary POC for lab help. Visit Casper as needed. Develop 4390 online lab.	Refine and teach 2390, 3800 and 4390 labs online. Serve as primary POC for lab help. Visit Casper as needed.	Teach 2390, 3800 and 4390 labs online. Serve as primary POC for above labs. Serve as secondary POC for senior designs. Visit Casper as needed.	Teach 2390, 3800 and 4390 labs online. Serve as primary POC for above labs. Serve as secondary POC for senior designs. Visit Casper as needed.
AP		Transition daily administration of program to Casper, then administer program. Develop and teach online electronics course and lab, be primary onsite POC for 2390, 3800, and electronics labs. Develop and teach required and elective CET	Administer program. Mentor/advise students. Refine and teach online electronics course and lab, be secondary onsite POC for 2390, 3800, 4390 labs. Develop and teach new CET course. Advise and mentor students; oversee internships. Travel to Laramie for trainings and updates. Professional	Administer program. Mentor/advise students. Teach online electronics course and lab, be secondary onsite POC for 2390, 3800, 4390 labs. Be primary onsite POC for senior designs. Refine and teach new CET course. Advise and mentor students; oversee internships. Travel to Laramie for trainings and updates.	Administer program. Mentor/advise students. Teach online electronics course and lab, new CET course, and be secondary onsite POC for 2390, 3800, 4390 labs. Be primary onsite POC for senior designs. Advise and mentor students; oversee internships. Travel to Laramie for trainings and updates. Professional

	<p>courses. Advise and mentor students; oversee internships. Travel to Laramie for trainings and updates. Professional development to stay technically relevant.</p>	<p>development to stay technically relevant.</p>	<p>Professional development to stay technically relevant.</p>	<p>development to stay technically relevant.</p>
<p>TT#2</p>		<p>Develop and teach two upper division online CET courses; mentor students; research/economic development. Develop methods to expand program across the state and beyond.</p>	<p>Teach two upper division CET courses; teach senior design I and II; mentor students; research/economic development.</p>	<p>Teach two upper division CET courses; teach senior design I and II; mentor students; research/economic development.</p>
<p>Under-grad</p>				<p>Serve as onsite POC for 2390, CET and 3800 labs</p>

Attachment 9: Computer Engineering Technology Degree – Course development summary

Computer Engineering Technology Degree

Table 1 Electrical and Electronics Fundamentals

	Campus	Format	Dept.	Course#	Title	Credits
1	Casper	On-site	ELTR	1515	Basic AC/DC Electronics	3
2	Casper	On-site	ELTR	1535	Electrical Power	3
3	Casper	On-site	ELTR	1605	Process Control	3
4	Casper	On-site	ELTR	2815	Prog. Logic Controller	3
5	Laramie	On-line	EE	2390	Digital Sys. Design	4
6	Casper	On-site	EE	2390	LAB	0
7	Casper	On-site	CET	3XXX*	Analog Electronics for Techs	4
8	Casper	On-site	CET	3XXX*	LAB	0
9	Laramie	On-line	EE	4390	Microprocessors	3
10	Casper	On-site	EE	4390	LAB	0
11	Laramie	On-line	EE	3XXX*	Design Experience with Devices	3
12	Casper	On-site	EE	3XXX*	LAB	0
13	Laramie	On-line	COSC	4760	Computer Networks	3
14	Laramie	On-line	EE	4820	Senior Design 1	2
15	Laramie	On-line	EE	4830	Senior Design 2	2
16	Casper	On-site	EE	4830	LAB	0

* New Course

Laramie (ECE): # of Courses: 5

Laramie (COSC): # of Courses: 1

Casper: # of Courses: 5

Casper: # of Labs: 5

Table 2 Software Fundamentals

	Campus	Format	Dept.	Course#	Title	Credits
1	Casper	On-site	COSC	1010	Intro to Computer Science 1	4
2	Casper	On-site	COSC	1010	LAB	0
3	Casper	On-site	COSC	1030	Computer Science I	4
4	Casper	On-site	COSC	1030	Computer LAB	0
5	Casper	On-site	COSC	2030	Computer Science II	4
6	Casper	On-site	COSC	2030	LAB	0
7	Casper	On-site	COSC	2800	Discrete Structures	3
8	Laramie	On-line	COSC	3050	Ethics for Computer Profession	1
9	Laramie	On-line	EE	3XXX*	Linux and Python Programming	3

* New Course

Laramie (ECE): # of Courses: 1

Laramie (COSC): # of Courses: 1

Casper: # of Courses: 4

Casper: # of Labs: 3

Table 3 Internship/Co-op

	Campus	Format	Dept.	Course#	Title	Credits
1		On-site /On-line	ES	4970	Internship/Co-op	6

- Should be eliminated and the credit hrs., should be added as electives

Table 4 Technology Track - Electives

	Campus	Format	Dept.	Course#	Title	Credits
1	Casper	On-site	ROBO	2590	Motion Control	3
2	Casper	On-site	ROBO	2595	Robot Systems	4
3	Casper	On-site	ROBO	1616	Robot Construction	2
4	Casper	On-site	ROBO	1610	Introduction to Robots	2
5	Laramie	On-line	EE	4xxx*	Internet of Things	3
6	Laramie	On-line	EE	4xxx*	Computer Vision and AI	3
7	Laramie	On-line	EE	4xxx*	Network Programming	3

* New Course

Laramie (ECE): # of Courses: 3

Laramie (COSC): # of Courses: 0

Casper: # of Courses: 0

Casper: # of Labs: 4

Table 5 Computer Science Track - Electives

	Campus	Format	Dept.	Course#	Title	Credits
1	Laramie	On-line	COSC	3020	Algorithms and Data Structures	4
2	Laramie	On-line	COSC		All other COSC Elective courses	

* New Course

Laramie (COSC): # of Courses: 1 +

Other Tracks:

- Education
- Sales
- Business
- Organizational Leadership
- ELTR

Attachment 10. Program Feedback

A draft of this degree program was shared with the Electrical and Computer Engineering Department Advisor Board on September 15, 2017. The following concerns for the program were expressed:

- Concerns about the direct benefit and return on investment to the State of Wyoming. It is unclear if graduates from the program could find employment within the State.
- UW at Casper. Concerns were expressed about the duplication of existing efforts and equipment at UW. Also, concerns were expressed for the large startup cost relative to UW without a clear picture of demand for the degree. Recommendations were made to start at UW to determine demand for the degree.
- How many students would want this degree rather than a Computer Science or Engineering degree? Its graduates would get paid as a technician [technologist], not as an engineer.

A program draft was reviewed with the Department of Electrical and Computer Engineering faculty and staff on September 22, 2017. The following concerns for the program were expressed:

- Professors of Practice expertise is essential in adapting existing coursework toward more applied activities including assembly, repair, and fabrication.
- The addition of a course in instrumentation and measurement was highly recommended.

The ECE faculty reviewed the program again on December 15, 2017 and it was suggested that new transfers should not be accepted until F'20, to give more time to bring the junior courses up and also to have more students in them once they were running. CC's robotics course should also be explicitly added as an elective, which may change some counting towards AS degrees.

On January 23, 2018 the final draft of the Computer Engineering Technology proposal was sent to the CEAS Academic Program Committee for review, comments, and also a committee vote. Results were quite mixed.

- APC vote results – Yes: 8, No: 4, Vote not provided: 1
- I (sfb) really value the wisdom of my colleagues. I have provided their comments below. I have tried to address all of their comments with additions and improvements to the proposal edition (Dec 21, 2017 version) that they reviewed. The following comments were provided:
 - “The reasoning for offering the program is not that compelling. Clearly the companies interviewed are hiring appropriate people without the CET program, so it’s not clear that it will result in any additional hires, merely the potential that the hires might have a different degree. In addition, the program will divert resources that I feel are much more badly needed in our current engineering majors.”
 - “I vote yes—in principal I think such a degree program could be worthwhile and provide an avenue for students seeking to work in computer technology but follow the traditional computer science path. However, I would like to add the following comments-
 - 1. It is difficult to justify the expenditures on a new program for which the ‘demand ... is unknown and difficult to quantify.’ Even if indicators suggest it might be popular. Target enrollments and growth should be specified at the very least.
 - 2. I don’t think it is a good philosophy to build a program entirely off of PoPs. Tenured and/or tenure track faculty should be involved. It is clear that the program will rely on just a couple of key personnel, that makes it susceptible to losing just one key person. This is not a very sustainable model, imo.
 - “My honest opinion follows along with some of the others that have been discussing this. I am not sure I see the value in this program. Based on the courses requirements, students would be taking courses that are already available except for 4 new courses (2 3000 and 2 4000 level courses). That to me does not constitute a new degree program but more of an option within a preexisting degree program. I am also concerned about the request for 2 professors of practice (with a third later on). I think this is a bad time to be requesting such large amounts of funding for personnel, especially given that it would appear at face value

that much of the additional work related to this program would be placed on the existing instructors. For these reasons, my vote is no at this time.”

- “I vote to support this proposal. On a broader scale, I wonder about the job market for graduates, and if this is the best use of limited resources. I think these concerns are outside of the committee’s charge, however.”
 - “I support this proposal. Frankly, if I was 20 years younger this would be right up my alley.”
 - “I vote no. There is currently a Computer Science Education certification available at the University of Wyoming. I do not see where this improves or adds anything that actually has a chance of getting a graduate employed in Wyoming. The students are not Computer Science, not Math, not Science. There is little or no money to hire such people in the elementary schools, with the possible exception of Jackson. And it is asking for multiple departments to have to provide class space for individuals in the degree plan and in the case of Computer Science to add a new course and for EE/EET to add/modify 3.”
- On February 15, 2018, Benjamin D. Wetzel, ASUW President sent the following message to AVP Anne Alexander: “Thanks for reaching out. After my review, and discussion with my executive team, we are happy to say that we support the CET, Construction Management, and the Cybersecurity proposals. Look forward to great things to come from these areas.”

Computer Engineering Technology Meeting – August 7, 2018:

Attendees

- AVP Anne Alexander, Academic Affairs
- AVP Kyle Moore, Enrollment Management (via phone)
- Dean Michael Pishko, College of Engineering and Applied Science
- Dean Paul Marquard, Casper College
- Dean Jeff Edgens, UW Casper
- Associate Dean Leslie Rush, College of Education
- Mark Lyford, Executive Director, Ellbogen CTL
- John McInroy, Department Head, Electrical and Computer Engineering
- Suresh Muknahallipatna, Professor, Electrical and Computer Engineering
- Steven Barrett, CEAS Associate Dean for Academic Programs

Purpose

- Discuss EAB “Market Demand for a Bachelor’s-Level Program in Computer Engineering Technology: Analysis of Regional and State Employer Demand, Program Characteristics, and Student Trends”
- Recommend to Academic Affairs paths forward.

Original Charter

Investigate concurrent degree in Computer Engineering Technology and Education as a possible remedy to address:

- Potential replacement for Industrial Arts education program,
- Enrollment challenges at UW Casper; and
- Provide Wyoming educators with computer related expertise to assist with the implementation of Senate File SF0029 “Education-computer science and computational thinking.” “AN ACT relating to education; adding computer science and computational thinking to the state educational program” by January 1, 2020.

EAB Report Observations

- Job posting data provided lumped together Computer Science, Computer Engineering, and Computer Engineering Technology.

- The number of CET graduates nationwide in 2016 was only 434.
- The total number of CET graduates pursuing an education career is very low.
- None of the profiled institutions offering CET programs included activities to prepare graduates to become educators.
- Concerns were expressed that a graduate of the concurrent major would likely pursue a career in Computer Engineering Technology as opposed to education due to the higher salary potential in engineering.
- The CET degree is similar to the Computer Engineering Degree. A student could complete an additional three math courses (Math 2210, Math 2310, and Math 2300) and obtain a Computer Engineering degree. The Computer Engineering degree has approximately \$20K of additional earning power per year over the CET degree.

Recommendation to Academic Affairs

Based on study, the group did not feel comfortable moving forward with a recommendation to further pursue the concurrent degree in Computer Engineering Technology and Education at this time. The projected low student demand and limited job prospects for program graduates does not support the startup program costs at this time. We recommend aggressively pursuing the alternatives described below.

What can we do – recommended alternatives -- action items

- Widely publicize existing Computer Science Endorsement/Minor to current UW students and educators state wide.
- If the interest exists with Wyoming educators, provide Distance Education access to coursework for the Computer Science Endorsement.
- Continue to publicize the Electrical and Computer Engineering Summer Program for Teachers (ESP4T) to STEM educators state wide. **See attached PPT on Physical Computing, Raspberry Pi, and Arduino Modules from the ESP4T workshops.**
- Develop a Computer Education Minor/Certification program for Education graduates and K-12 teachers. The minor would contain 18 to 27 credits consisting of Computer Science and Computer Engineering specifically Physical Computing courses. **See attached PPT on Physical Computing.**
- Develop series of stackable certificates for post-Associate and post-Bachelor students. Investigate feasibility of Distance Education course access. Potential topics:
 - Physical computing concepts for K-5 educators
 - Physical computing concepts for 6-12 educators
 - Process control (PLCs, instrumentation, etc.)
- Investigate feasibility of summer "boot camp" to help prepare students to pursue certificate programs.
- Investigate potential funding sources (CAEDA, Ellbogen Foundation, etc.)
- Investigate developing a four year BS Computer Engineering – Internet of Things (IoT) Bachelor Degree.
 - In the next few years, billions of IoT devices will be connected worldwide. This new wave of technology will spearhead the demand for highly trained IoT specialists.
 - "When companies hire a computer science graduate, that employee focuses mainly on software aspects and programming,"
 - "When companies hire a computer engineer, that person is expected to focus mainly on the hardware aspect, but not on end-use applications involving both hardware and software.
 - A Computer Engineering – IoT graduate will have the skillsets and prepared to find jobs working on microcontrollers and sensors; software engineers, programming smart devices; wireless communication specialists, focusing on how the devices communicate with each other; and cybersecurity professionals, protecting the data and keeping consumers safe from hackers.

1.

September 12, 2018 Update

Trustee True, President Nichols, Provost Miller, and Casper community leaders have indicated an interest in continuing to pursue degree development.

Dean Pishko has emphasized the following:

- UW is assuming a calculated risk in pursuing this degree.
- The degree will require active recruiting throughout the region as a destination degree.
- CEAS can not move forward on degree development without additional funding for faculty and equipment as described in this proposal.

Dean Pishko met with President Nichols, Provost Miller, and Dean Jeff Edgens. The following is the recommend course of action moving forward:

- Move forward with a soft program rollout in Fall 2019 serving freshmen only.
- Launch search for first faculty member in Summer 2019 (senior academic professional, professor of practice, or assistant professor – this will be determined by the Department of Electrical and Computer Engineering).
- Launch search for second faculty member in Fall 2020.
- Begin accepting transfer students in Fall 2021 (year 3).
- To do:
 - Send revised proposal back to Faculty Senate for review and approval in September 2018.
 - Contact Ellbogen Foundation for possible laboratory equipment support.
 - Submit proposal to Board of Trustees for review in November 2018.
 - Develop Memorandum of Understanding with Casper College for laboratory use agreement.
 - Dean Pishko will request letters of support from Casper regional business leaders.

October 18, 2018

Proposal provided to Faculty Senate Academic Program Committee for review.

November 9, 2018

Updated proposal provided to Faculty Senate Academic Program Committee for review.

November 16, 2018

Dr. Steven Barrett and Dean Edgens (UW C) reviewed the proposal with the Central Wyoming Board of Cooperative Educational Services (BOCES).

January 8, 2019

Dr. Steven Barrett and Dean Edgens (UW C) reviewed the proposal with the UW C Advisory Board.

January 15, 2019

Updated proposal provided to Faculty Senate Academic Program Committee for review.

February 14, 2019 Update

Leslie Rush and Steven Barrett met with representatives from the Faculty Senate Academic Program Committee on February 14. We had a follow up meeting with AVP Anne Alexander on February 19. She reviewed with us the APC's concerns with the degree:

- Low benefit/cost ratio. The projected cost of the program does not balance well with the low student and employer interest projected by Gray and Associates.
- Discussion items:
 - Is it possible to reduce the cost of delivering the program (e.g. fund raising for faculty positions)?
 - Is it possible to increase the demand for the program (e.g. renaming the program to a degree better supported by Gray and Associates projections)? This will have an impact on degree content and requirements. The name chosen for a program drives ABET accreditation requirements.

February 26, 2019

A revised proposal was submitted to the Faculty Senate Academic Program Committee for a degree in Computer Engineering Technology for the Industrial Internet of Things (CET-IIOT). In response to the concerns expressed by the APC, sections were added on demand (pages 3-5) and cost/benefit analysis (11-12).

March 29, 2019

The Faculty Senate Academic Program Committee provided their recommendation on the revised the revised CET-IIOT proposal. The recommendation is provided at Appendix 11.

Associate Provost Anne Alexander referred a proposal for a Bachelor of Science (BS) in Computer Engineering Technology (CET) to the Academic Planning Committee (APC) for review and recommendation. After careful consideration of the initial iteration of the proposal, the APC voted unanimously not to recommend implementation of the program. After consultation with Assoc. Provost Alexander, the proposal was referred back to the College of Engineering and Applied Science (CEAS) for revisions to address the APC's concerns. The revised proposal calls for a BS in Computer Engineering Technology for the Industrial Internet of Things (CET-IIOT). An IIOT-focused program may present an opportunity for the university, but in its current iteration, the CET-IIOT proposal appears to be largely a rebranding of the CET program with any changes as a result of the new IIOT focus largely undefined and any benefits largely unquantified.

Without more, the revised proposal appears to suffer from the same shortcomings as the initial proposal. Accordingly, the APC again unanimously voted¹ not to recommend implementation. One concern centers on the reasonably expected value of the program relative to its considerable costs. The proposed program is a 2+2 plan to be jointly offered by Casper College, UW Casper, and the UW CEAS. The investment in the program (\$500,000 annually in perpetuity, by AY24-25, p. 11) is said to be appropriate because it “would create in Casper a very new, highly technical, lab intensive, four year ABET-accredited program which differs markedly from anything offered at UW” (p. 1). While that may be true, the proposal does not provide a convincing case that sufficient student demand or pressing state need for the program exists to justify such significant new and ongoing expenditures.

The program projects enrollment of 25 resident and 25 non-resident students by AY24-25 (p. 11). The rationale for those projections is not elucidated, however, and there are several objective reasons to be skeptical of student demand. In 2016, only 434 CET degrees were awarded *nationwide* (p. 5), and institutions with much higher enrollments than UW graduate very few students annually – on average only 9 (Appendix 6, p. 29). The largest program nationwide has

¹ There were two abstentions: one from the Associate Dean of UW-Casper and the other from the representative from the College of Engineering.

shrunk 25% (p. 29). Moreover, the program assumes a 2+2 model, but the potential feeder programs at Casper College graduate only a small number of students. It may also be worth confirming that Casper College remains supportive of such a feeder program, even after receiving permission from the legislature to institute its own BAS degrees. The proposal concedes that it is difficult to predict how many, if any, students that start in Laramie would be willing to move to Casper to complete this degree. Further, demand for this degree will be challenged on both ends: on the upper end by students who elect to instead complete the more rigorous and profitable computer engineering degree and on the lower end by students who opt to enter the workforce after completing a two-year program.

Perhaps most concerning, even if the program could generate student demand, it is not at all clear that students would be well-served by this program. Salaries for technicians (two-year program) and technologists (proposed four-year program) are identical. Financially, there appears to be little or no advantage to completing the technology degree. Likewise, most jobs either require a computer engineering degree or accept an associate's degree (if any degree is required at all). Moreover, salaries for both technicians and technologists have remained "flat for over the past 40 years (remaining at an average of about \$50,000 annually, in 2015 dollars)" (p. 2).

In contrast, average real wages for engineers have risen 23% annually over that timeframe. The four-year engineering degree (already in place at UW) is a far better investment for students, especially since the technologist degree will also entail Calculus II (p. 4). With three more math classes, students can obtain a computer engineering degree that will enable them to command \$20,000 more per year for the duration of their careers (p. 15). They will also become eligible for substantially more jobs and for licensure in all states. It is argued that the CET-IIOT is a better option for those students who desire a more hands-on education than provided by the theoretically oriented engineering degree, but a technician degree is also hands on, equally lucrative, and takes half the time to complete.

Apart from the lack of remuneration to be gained from the degree, employer demand appears uncertain, at best. According to the initial CET proposal, Gray and Associates data (p. 5) rates CET programs "4" online and "6" on the ground, reflecting demand exceedingly low student and employer demand.² An "unscientific survey" of companies that recruit from the UW computer science engineering programs indicated mixed interest in hiring job candidates with a CET degree, and there is little evidence of demand within Wyoming (p. 7). The proposed degree also aims to provide a concurrent secondary education major plan for licensure in Wyoming, but the requirements of the proposed CET-IIOT degree appear to extend far beyond what is taught in Wyoming high schools (p. 10). It is not clear that this concurrent major is a good avenue to licensure. Very few CET graduates pursue an education career (p. 5), and a Computer Science Certification that requires only 20 semester hours of credit is already available at UW (<http://www.uwyo.edu/education/current-students/certificate-endorsement.html>).

Also worrisome, the engineering faculty appears to share some of the APC's concerns. The Electrical and Computer Engineering Advisory Board approved a draft of the degree proposal only on a split vote (pp. 14-15). The Board members' comments reflect that significant concerns were expressed about the cost of and demand for the proposed program, even by those who voted in favor of the proposal.

² The revised proposal presents a somewhat higher overall score for CET from Gray's, but no explanation is provided for the change. Moreover, student demand remains a *negative* number.

It should be noted that the concerns expressed herein relate to the proposal before the committee. A more developed IOT-focused proposal may present a stronger case. However, the current proposal appears to rebrand the CET proposal as CET-IOT without substantively revising the curriculum, leaving the committee unclear on how effectively and to what extent IOT will be incorporated. The new proposal does present some job posting data that suggests promise with an IOT-oriented program, but such data fails to link job postings to required credentials and to salaries. If a bachelor degree is not required for the jobs posted, as is often the case for CET jobs, the jobs posted do not necessarily support implementation of a costly new four-year degree program. Similarly, if such jobs do not command any higher salary than may be obtained without a degree, they would not materially change the committee's analysis. Likewise, at present, there is also little data to suggest IOT student demand. Addressing these issues will require a thorough revision of the present proposal.

In sum, while the current proposal extols the virtues of the CET-IOT degree, it provides little evidence that such program is a wise investment of University resources during a period of austerity in which many well-established programs lack adequate funding. The considerable annual expenses associated with this program would be difficult, if not impossible, to reduce once the program is launched if demand does not materialize. There is reason to be skeptical of student demand and employer demand, and significant concern that students could be made worse off if they graduate and have no better salaries and job opportunities than they would have had without the degree. At this time, the APC opposes implementation of this degree program.

April 1, 2019

AVP Dr. Anne Alexander and Dr. Steven Barrett met with the Executive Committee of Faculty Senate to discuss the proposal. Here is a summary of their concerns:

- “Expected value of the program relative to its considerable cost” - the projected enrollment would put the program in the category of a low producing program
- “The proposal does not provide a convincing case that sufficient student demand or pressing state need”
- “The current proposal appears to rebrand the CET proposal as CET-IOT without substantively revising the curriculum, leaving committee members unclear on how to effectively and to what extent IOT will be incorporated.
- “The new proposal does present some job posting data that suggest promise with an IOT-oriented program, but such data fails to link job postings to required credentials and to salaries.”
- Is this the right program to fill these positions?, Is there one better suited?, Could students obtain the skill set from a less risky approach (e.g. an IOT minor)?

April 2, 2019

Professor David Bagley provided his comments on the program. They have been included in this document.

April 7, 2019

The proposal was updated to address the concerns expressed by the APC on April 1, 2019.

April 8, 2019

Dr. David Bagley, Dr. John McInroy, and Dr. Steven Barrett presented information to the Faculty Senate on the proposed CET-IIoT degree program.

On behalf of the College of Engineering and Applied Science, I am pleased to present the College's proposal for a Bachelor of Science Degree in Computer Engineering Technology – Industrial Internet of Things (CET-IIOT). The Department Head of Electrical and Computer Engineering, Dr. John McInroy is also here – my thanks to John for rearranging his schedule to attend. Also joining us by phone are Associate Dean Steven Barrett and Dean Michael Pishko. My thanks to them for attending as well. Once I am done, I will ask if they have anything to add and then open it up for questions.

You have seen the recommendation from the Academic Planning Committee and their concerns. The APC provided a thorough review and their concerns provided additional areas for improvement of the proposal. The proposal you received today incorporates changes made to help address the concerns presented by the APC (in red text in the proposal).

I would like to make eight (8) points that I hope will help you evaluate this proposal. **First**, this is a bachelor's degree in *Engineering Technology*. Neither UW nor any of our community colleges has delivered this degree before, but it is only new to Wyoming. Other engineering programs offer bachelor's degrees in engineering and in engineering technology. If you are not familiar with engineering technology, you are not alone. As indicated on page 2 "Engineering technology (ET) is unfamiliar to most Americans and goes unmentioned in most policy discussions about the US technical workforce." The proposal describes the relationship between engineering and engineering technology on pages 1 and 2, ending at the top of page 3. I encourage you to examine that information.

I would note that engineering technology degrees can be ABET accredited, just as engineering degrees are. This proposed program would become ABET accredited, just as all of UW's engineering degrees are. ABET-accreditation is the first step in licensure for all engineering and engineering technology graduates across the country (and in a growing number of international jurisdictions).

Second, the Industrial Internet of Things is an increasing area of emphasis and need in industry. The description on page 3 provides a brief overview of the field while Appendix 12 provides additional information about job opportunities. I want to note three points that are easy to miss.

One: the term "industrial sectors" is used as a catchall after "transport" and "energy" for areas of application. That is because "industrial sectors" includes EVERY industry that uses machinery. Here in Wyoming, we have a large "industrial sector": trona mining and chemical processing. It is located in the Green River area and is often overshadowed by the energy industry. Their need for employees with IIOT-related skills and knowledge is nevertheless strong and they often must resort to hiring employees from outside of Wyoming because UW is not graduating individuals with the desired skill sets.

Two: the proposal mentions healthcare. This means all the technology involved in healthcare – sensors attached to people linked to computer systems to collect and analyze data and also to alert healthcare professionals in emergencies, etc.

Three: on page 44 (Appendix 12) an advertisement for a Field Application Engineer for Temboo notes: "Temboo is empowering people to build an amazingly diverse range of physical computing systems at the intersection of hardware, software and human aspiration..." That is an inspiring and succinct description of IIOT.

Third, this degree is distinct from any current degrees offered at UW. The degrees that may seem similar are Computer Science and Computer Engineering. A comparison of the curricula will show quickly, though, that CET-IIOT is not the same as either (the CET-IIOT curriculum is shown on page 25 in Appendix 2). The proposal now highlights on page 10 the *new* courses that are being introduced, three of which will be required. It also notes that four of the required courses that will be offered by Casper College (with the prefix ELTR) are not offered at UW but contain content critical to the CET-IIOT degree.

This said, graduates from Computer Science and Computer Engineering could work at the jobs targeted by the CET-IIOT program. But so could Electrical Engineering graduates and also graduates with degrees in Mechanical Engineering, Chemical Engineering, Civil Engineering, Architectural Engineering, Petroleum Engineering, Mathematics, Physics and likely several other fields. I know – my son (with degrees in mathematics and physics from UW) and a friend and colleague of his, also a Laramie High/UW graduate but with a degree in mechanical engineering, work for a start-up firm in Laramie (Logilube) that is in the IIOT business. Both of these young men, though, are *self-taught* in the specifics of IIOT technology. Graduates of a UW CET-IIOT program would be highly suitable for positions in firms like Logilube and be *immediately productive*.

Fourth, the CET-IIOT degree is a legitimate bachelor's degree. Its uniqueness in having required coursework that is also taken by individuals who are only pursuing two-year degrees simply reflects the more applied focus of engineering technology versus engineering. The required upper division courses are not found in any two-year degree programs.

Fifth, the CET-IIOT degree is not suitable as a bachelor's of applied science (BAS) for two reasons:

One, the BAS degree cannot be ABET-accredited. The College will not offer engineering or engineering technology degrees that are not ABET-accredited.

Two, the BAS degree bases its technical content almost exclusively on the associate's level material, using the other two years to provide the necessary general education expected in a bachelor's degree. The CET-IIOT degree uses associate's level material but also adds upper division technical content, e.g. COSC 4670 (Computer Networks) as well as lower-division content, e.g., MATH 2200 and MATH 2205 (Calculus I and II) that are not part of associates of applied science (AAS) degrees.

Sixth, there is a strong demand for graduates with IIOT skills but this was not clearly recognized by the Gray's analysis in the original proposal. It turns out that as useful as the Gray Associates' Program Evaluation System (PES) is, it is difficult

to use for analysis of a field like IIOT. To test this, Dean Pishko did a PES analysis for a hypothetical mechanical engineering program in Casper. To quote Dean Pishko:

"If one relied only on this analysis, one would never start a ME degree in Casper. Yet we all know that the ME degree is the largest degree at the UW campus, the most popular engineering degree in the country, and highly in demand in a very large number of industries. Around Casper, that would be in everything from energy production (oil and gas, wind), mining (coal, uranium), heavy machinery (L&H), to medical devices (McGinley). Gray can't fully capture this unless you include manufacturing engineers, systems engineers, power engineers, mining engineers, etc. This is why you can't rely on Gray exclusively. You must also talk to potential employers and discuss what you teach, not just the degree name."

To help quantify this, Associate Dean Barrett went to Indeed.com and expanded his analysis to include the range of jobs that a CET-IIOT graduate would be well-trained for. His results are summarized on page 4 with samples of the jobs available noted in Appendix 12. From this analysis, the appropriate salary range to consider for CET-IIOT graduates is \$80,000 to \$135,000.

Seventh, yes, mounting this new degree will incur costs. We can raise money to support this program but donors want to see that UW supports the program first because they know that only UW can make this happen – the community colleges alone cannot do it. I understand the financial concern noted in the draft resolution that "many well-established programs lack[ing] adequate funding and personnel" – I work in one of those programs and I imagine every one of you do too. I don't have an easy answer for this challenge – we face it every time a new program idea comes along. We just have to evaluate each program on its academic merits.

Eighth and finally, this degree is an exciting opportunity to engage Casper College and UW Casper. This degree program is highly anticipated by local stakeholders. It shows that UW responds to the needs of the state, just as it has with the new degrees in Outdoor Recreation and Construction Management, but that not everything UW does has to run through Laramie. We will partner with our community colleges to better meet the higher education needs of the State.

In conclusion, I think this new degree is worth the initial risk required. It is unique, it is well-constructed, it will prepare graduates to be immediately productive in this new and rapidly evolving field, it expands UW's ability to offer degrees in conjunction with our community college partners, and it is responsive to the State's needs. I encourage you to spend some time reading the proposal and asking questions.

Dr. McInroy, would you like to add anything?

Associate Dean Barrett, would you like to add anything?

Dean Pishko, would you like to add anything?

Thank you. Are there any questions from the Senate?

The Faculty Senate requested the following information for their April 22, 2019 meeting and vote on the proposal:

- Stakeholders should be present to describe their interest in the program (Dean Pishko, Jeff, Brent)
- Projected enrollment still puts the program in the area of an "under producing program" (Steven)
- Can the costs be refined/reduced? (Steven)
- Can the ECE Department review the revised proposal and take another vote (John)
- How does UW C plan to handle the program (Jeff, Brent)

April 9, 2019

A revised proposal was sent to the ECE Department for a Friday, April 12, 2019 vote.

April 12, 2019

The Department of Electrical and Computer Engineering met and discussed the proposal at length. From the meeting minutes: "The following statement was moved by JWP and seconded by SM: "ECE was asked to develop a CET degree program. We developed it to the best of our ability. There is interest by our state legislature in 4-year technology degrees. We feel this degree satisfies this interest in the computer engineer technology area." This statement was voted upon, with 9 approving it, 1 voting against, and 1 abstaining."

April 16, 2019

From Professor Brent Pickett, University of Wyoming at Casper.

There were two main queries you had posed re: UW-Casper.

1. Stakeholders should describe their interest in the program.
 - a. Please note that, as far as I am aware, this would be the first College of Engineering program delivered at the University's sole branch campus. UW-Casper is eager to work with the College of Engineering and will devote a lot of time and energy to ensuring the success of this program.
 - b. Jeff said that he would contact the executive director of the Casper Area Economic Development Alliance (CAEDA) to secure a letter of support. In addition, he was hoping for a commitment of specific resources from CAEDA, rather than just a general expression of support. I don't know where that conversation is, however.
2. How does UW-Casper plan to handle the program? As soon as the UW Board of Trustees votes to approve the program, we will:
 - a. Work with the relevant Casper College (CC) personnel to ensure that advising and student recruitment works well in the relevant CC feeder programs.
 - b. Put together grant requests (it may work better as 3 separate requests) to the Central Wyoming Board of Cooperative Educational Services (BOCES) to request funds for equipment purchases, recruiting efforts, and marketing costs. Associate Dean Pickett has already talked with that Board about asking for marketing expenses and there was no objection. Those three categories together could add up to a total in the range of \$150,000 and still have a reasonable chance of passing, we believe.
 - c. We will work with CAEDA and the local Chamber of Commerce to encourage student recruitment, including by people already in the computing field.
 - d. As faculty are hired, we have space to accommodate them in the University/Union building on the CC campus.
 - e. As faculty are hired, we will work to have them engaged with CC faculty in the relevant feeder programs, since that will be important to recruitment, smooth transfer from CC to UW, and keeping the relevant coursework and major requirements aligned between the two institutions.

