**CONNECTICUT BOARD OF REGENTS FOR HIGHER EDUCATION**

**Connecticut State Colleges & Universities**

*Concept Paper for New Academic Program*

## INTRODUCTION

The *Concept Paper* is the initial draft of the *Application for* **New Program Approval** with which the initiator(s) should become familiar. Submission of the *Concept Paper* to the CSCU Academic Council affords the initiator(s) the opportunity to receive critical, informative feedback from the System's chief academic officers; whose endorsement is a prerequisite for submission of the *Application* to the Board's Academic and Student Affairs Committee that decides upon program approval.

**NOTE:** The Microsoft Word text boxes below are expandable and the *Concept Paper* is limited to five pages.

## PROPOSED NEW PROGRAM

**Title of Proposed New Program:** Electrical Engineering
**Title of Credential:** Bachelor of Science
**Total Number of Course Credits Required:** 128
**Institution and Institutional Unit:** **Central Connecticut State University,** The School of Engineering, Science and Technology (SEST), The Computer Electronics and Graphics Technology Department
**Initiator(s)/Faculty Status and/or Position:** Dr. Karen Tracey – Department Chair, Dr. David Broderick, Dr. Sangho Park, Dr. Deborah Zanella

**Directions:** Summarize the investigative research, academic development, student interest, and/or any business/industry or service involvement that led to the generation of the idea for the proposed academic program.

The Computer, Electronics and Graphics Technology Department within the School of Engineering, Science and Technology (SEST) at Central Connecticut State University is proposing a Bachelor of Science in Electrical Engineering (EE). The Bachelor of Science in Electrical Engineering (EE) will recruit students from within the State of Connecticut, and the geographical region. The affordability and accessibility of CCSU will allow a diverse population to gain greater earning potential that will in turn promote economic growth and social justice.

The proposed program leverages the strengths of Central Connecticut State University and the School Engineering, Science, and Technology. Currently at CCSU, there are degree programs offered in Mechanical Engineering and Civil Engineering. These programs contain significant overlap with the proposed Electrical Engineering program. The proposed program will have the following attributes:

- Effective response to Connecticut workforce demands and involvement in applied research with local industries - As the second largest public university in Connecticut and the largest within the CSU System, the university has existing programs in mechanical and civil engineering and it is prudent to add an electrical engineering program.
- Accessible and affordable engineering education for Connecticut residents – the CSU system capitalizes on its unique location in Connecticut to provide access to current and prospective engineering students through active recruitment within the largest Connecticut academic educational system.
- Reaching out to diverse, underrepresented, and minority groups – CCSU provides a welcoming environment for first generation students, individual attention, and an array of different programs for various professional careers enabling seamless transfer within the same school.

- Experience and commitment to transfer students from Community Colleges - The School of Engineering, Science and Technology has supported and been actively involved with the implementation of the pathway agreement with the Connecticut Community Colleges..
- Retention of Graduates within CSU System vs. CT State - According to the CSU System Statistical Reports, over 85% of undergraduate and 91% of graduate students are state residents. At the same time, according to regional graduate retention data (New England's Knowledge Corridor), less than 30% of all graduates definitely want to stay in the region, while half plan to leave New England after graduation.

## NEED

**Directions:** See "Addressing Identified Needs" in Section 2 of the *Application for* **New Program Approval** and state the need(s) to be addressed by the proposed academic program and the manner in which the proposed program would address the described need(s).

**Demand for Skilled Workers in Manufacturing by 2018**

| POSITION | JOB NEEDS STATEWIDE |
|---|---|
| Entry-level | 3,324 |
| Engineers | 2,245 |
| Electrical engineers | 1,752 |
| Welders | 1,650 |
| Mechanical engineers | 1,236 |
| Machinists | 1,048 |
| Quality control | 821 |
| Warehousing | 508 |
| CNC machinists | 407 |
| Tool & die makers | 282 |
| CNC programmers | 156 |
| Transportation | 86 |
| CAD/AM | 55 |
| Drivers | 31 |
| **TOTAL** | **13,601** |

The 2017 survey of Connecticut Manufacturing Workforce Needs by the Connecticut Business & Industry Association (CBIA) reveals a profound need for additional **Electrical Engineers** in the Connecticut workforce.[1] From that source, Table 1 summarizes the state-wide needs for technical occupations. **Electrical Engineers** are the third most in-demand occupation and the most in-demand occupation with a specific job title with 1,752 positions open. These sources suggest that the US, as a whole, will be adding jobs for Electrical Engineers while Connecticut's growth will be slightly negative. Nevertheless, if the number jobs remain constant, Connecticut does not educate sufficient numbers of Electrical Engineers and companies recruit from out of state to fill openings. In reality the specific job title in Electrical Engineers will be impressive positive as growing the retired, the current engineers transfer out of state, and the change in the state etc.

[1] *2017 Survey of Connecticut Manufacturing Workforce Needs. (2017) Hartford, CT: Connecticut Business & Industry Association.*

[6] *Labor Market Information. (2017, November 5). Retrieved from State of Connecticut Department of Labor: http://www1.ctdol.state.ct.us/jcc/profile.asp?strMethod=keyword&sstrOccupationCode=172071*

| Institution | Degree | 2012 | 2013 | 2014 | 2015 | 2016 | 2017* |
|---|---|---|---|---|---|---|---|
| Fairfield University | Electrical Engineering, BS | 9 | 6 | 10 | 5 | 10 | 11 |
| US Coast Guard Academy | Electrical Engineering, BS | 11 | 16 | 21 | 19 | 13 | 14 |
| University of Connecticut | Electrical Engineering, BSE | 34 | 43 | 55 | 53 | 58 | 73 |
| University of Hartford | Electrical Engineering, BSEE | 17 | 12 | 12 | 12 | 16 | 26 |
| University of New Haven | Electrical Engineering, BS | 7 | 10 | 13 | 21 | 22 | 16 |
| Yale University | Electrical Engineering, BS | 2 | 2 | 2 | 5 | 4 | 18 |
| | | | | | | | |
| Total | | 80 | 89 | 113 | 115 | 123 | 158 |

*Table 1 Graduates with Similar Degrees from Connecticut Institutions*
* Official and final data is not published yet.

Table 1 summarizes the number of graduates from nationally accredited (by ABET) programs granting a degree similar to the degree proposed in this paper. These institutions are located in Connecticut and represent both private and public universities and academies. While the total number of graduates continues to grow over the years surveyed, the number of graduates remains less than a tenth of the number of Electrical Engineers needed in Connecticut in 2018. The Connecticut State University System has traditionally been an engine of social mobility and economic growth. The addition of an Electrical Engineering program follows in that tradition as it serves the needs of industry in Connecticut and the graduates of the program.

## STUDENT LEARNING OUTCOMES

**Directions:** Broadly define the SLOs to be addressed by the proposed academic program and concisely describe assessment methodologies to be used in measuring the outcomes.

**Learning Outcomes (L.O)** to meet ABET requirements:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## CURRICULUM

**Directions:** Provide a "Program Outline" as prescribed under Curriculum **(page 4)** of the *Application for* **New Program Approval**.

### Curriculum

*(Please list courses for the proposed program, including the core/major area of specialization, prerequisites, electives, required general education courses (undergraduate programs), etc. Using numerals, map the Learning Outcomes listed in the previous section to relevant program courses in this table. Mark any new courses with an asterisk * and attach course descriptions. Mark any courses that are delivered fully online with a double asterisk ** Please modify this format as needed)*

| Course Number and Name | L.O. # [2] | Pre-Requisite | Cr Hrs | Course Number and Name | L.O. # | Cr Hrs |
|---|---|---|---|---|---|---|
| **Program Core Courses** | | | | **Other Related/Special Requirements*** | | |
| EE 101 (L) – Electric Circuits I | 1, 5 | Math 152; Phys 125 (concur) | 3 | Engr 150 – Intro to Engineering | 1, 3, 4, 5 | 3 |
| EE 201 (L) – Electric Circuits II | 1, 6, 7 | EE 201 | 3 | Engr 240 – Computations Meth for Engineers (Preq: Math 152, Eng 105/110) | 1, 2, 7 | 3 |
| EE 212 (L) – Fund. Of Logic Design | 1, 2 | Engr 240 | 3 | Chem 161 – General Chemistry | 1, 7 | 3 |
| EE 301 – Signals & Systems | 1, 7 | EE 201. Math 221, Phys 126 | 3 | Chem 162 – Gen Chemistry Lab | 1, 6 | 1 |
| EE 331 (L) – Intro to Semiconductors | 1, 6 | EE 201 | 3 | Math 222 – Cal III | 1, 7 | 4 |
| EE 312 - Computer Systems | 1, 2 | EE 212 | 3 | Math 226 – Linear Algebra & Prob for Engrs | 1, 7 | 4 |
| EE 313 (L) – Electric Energy Eng. I | 1, 6 | Math 222, Engr 240 | 3 | Math 355 – Intro Differential Equations w/Appl. | 1, 7 | 4 |
| EE 323 (L) – Electric Energy Eng. II | 2, 6 | EE 313 | 3 | | | |
| EE324 (L) – Control Systems I | 1, 2 | EE 301 | 3 | | | |
| EE 330 – Electromagnetics | 1, 7 | Math 222 | 3 | | | |
| EE 333 (L) – Electric Machines & Motors I | 1, 6 | EE 201 | 3 | | | |
| EE 343 (L) - Electric Machines & Motors II | 2, 6 | EE 333 | 3 | | | |
| EE 351 (L) – Analog Circuits Design | 1, 6 | EE 331 | 3 | | | |
| EE 352 (L) – Signal Processing & Pattern Analysis | 1, 7 | Math 226, Engr 240 | 3 | | | |
| EE 353 (L) – Energy Storage System | 1, 2, 4 | EE323 | 3 | | | |
| EE 363 (L) – Renewable Energy I | 1, 2, 4 | EE 323 | 3 | | | |
| EE 401 – Random Signals & Systems | 1, 7 | EE 301, Math 226 | 3 | | | |
| EE 424 (L) – Controls Systems II | 2, 6 | EE 324 | 3 | | | |
| EE 430 (L) – RF Communications | 1, 7 | EE 330 | 3 | | | |
| EE 497 – Capstone Project I | 2, 3, 5, 7 | EE 343, EE 430 | 2 | | | |
| EE 498 – Capstone Project II | 2, 3, 4, 5 | EE 498 | 2 | | | |
| **Core Course Prerequisites** | | | | **Elective Courses in the Field** | | |

[2] From the Learning Outcomes enumerated list provided at the beginning of Section 3 of this application

| | | | | |
|---|---|---|---|---|
| Phys 125 – University Physics I (SA IV) | 4 | Directed Elective in EE, ME, ENGR | | 3 |
| Phys 126 – University Physics II (SA IV) | 4 | Renewable Energy II | 2, 4, 6 | 3 |
| Eng 105 or Eng 110 – (SK I) | 3 | Electrical Metrology | 1, 6, 7 | 3 |
| Engr 290 – (SK I) | 3 | Power Electronics | 1, 2, 4 | 3 |
| Math 152 – Calc I (SK II) | 4 | Engineering Ethics | 3, 4 | 3 |
| Math 221 – Calc II (SK II) | 4 | | | |
| | | | | |
| **Total Other Credits Required to Issue Credential** *(e.g. GenEd/Liberal Arts Core/Liberal Ed Program)* | | | | |

SA I – 6 credits: Literature (recommend Eng 203 or Eng 204), Phil 144

SA II – 6 credits: History (recommend international), Econ 200 or Econ 201

SA III – 6 credits:

SA IV: requirements stated above

SK I: requirements stated above

SK II: : requirements stated above

SK III: Foreign Language (refer to catalog)

SK IV: PE 144 (refer to the catalog for transfer students with over 15 credits)

## SPECIAL RESOURCES

**Directions:** Provide a brief description of resources that would be needed specifically for the proposed program and how they will be used; e.g. new faculty, laboratory equipment, specialized library collections, etc. Include in this discussion what would be the sources of revenue.

The Computer Engineering Technology and Electronics Technology programs currently use facilities in Copernicus Hall at CCSU to teach related courses. Upon completion of the Engineering Building on the New Britain campus, additional space/laboratories will become available to all electric classes. Equipment will be needed to teach the new courses for the Electrical Engineering program, which will ultimately be located in the new Engineering Building.

There will be the need for at least **2 full-time faculty** and some part-time adjuncts.

| Name of the Laboratory | | |
|---|---|---|
| **Laboratory of Power Engineering**: Power Generation, Power Transmission and Distribution, Protection Techniques, Energy Utilization and Efficiency | 2 | $415,000.00 |
| **Laboratory of Renewable Energies**: Photovoltaic, Wind, Solar Thermal, Solar Energy Collector, Fuel Cells | 1 | $550,000.00 |
| **Laboratory of Electric Machines and Motors**: Dissectible Machines, DC Motor Control Trainer, Synchronous Machines, Single and Three Phase Transformers, and Motor Speed Control | 6 | $58,400.00 |
| **Laboratory of Energy Storage Systems**: The Energy Storage Systems Technologies – Mechanical, Electrochemical, Chemical, Electrical and Thermal. Energy Storage Effectively Stabilizes the Electric Grid, Categories of Commercial Scale Batteries, Rechargeable Batteries, The Role of Hydropower Generation, The Thermal Power Plants. The Energy Storage Technologies - Generation Responses by Technology. | 1 | $180,000.00 |
| | | |
| Total Cost of Electrical Engineering Laboratories | | $1,910,400.00 |