*STATE COUNCIL OF HIGHER EDUCATION FOR VIRGINIA*
## PROGRAM PROPOSAL COVER SHEET

| | |
|---|---|
| 1. Institution<br><br>Old Dominion University | 2. Academic Program (Check one):<br>New program proposal ___X___<br>Spin-off proposal ______<br>Certificate document ______ |
| 3. Name/title of proposed program<br>Electrical and Computer Engineering | 4. CIP code<br>14.4701 |
| 5. Degree/certificate designation<br>Master of Science | 6. Term and year of initiation<br>Fall 2025 |
| 7a. For a proposed spin-off, title and degree designation of existing degree program<br><br>7b. CIP code (existing program) | |
| 8. Term and year of first graduates<br>Spring 2031 | 9. Date approved by Board of Visitors |
| 10. For community colleges:<br>date approved by local board<br>date approved by State Board for Community Colleges | |
| 11. If collaborative or joint program, identify collaborating institution(s) and attach letter(s) of intent/support from corresponding chief academic officers(s) | |
| 12. Location of program within institution (complete for every level, as appropriate and specify the unit from the choices).<br><br>Departments(s) or division of ___Electrical and Computer Engineering___<br><br>School(s) or college(s) of ___The Graduate School___<br><br>Campus(es) or off-campus site(s) ___Main Campus, Norfolk___<br><br>Mode(s) of delivery: face-to-face _____ distance (51% or more web-based) _______<br>hybrid (both face-to-face and distance) ___X___ | |

13. Name, title, telephone number, and e-mail address of person(s) other than the institution's chief academic officer who may be contacted by or may be expected to contact Council staff regarding this program proposal.
Jeanie Kline, Ed.D., SCHEV Liaison, 757.683.3261, jkline@odu.edu

**TABLE OF CONTENTS**

Part I: Description of the Proposed Program

## A. Program Background

Old Dominion University in Norfolk, Virginia requests approval to initiate a Master of Science (M.S.) degree program in Electrical and Computer Engineering (ECE) with CIP Code 14.4701. This proposed degree program will supersede the concentration in ECE of the M.S. in General Engineering degree with CIP Code 14.0101 that is currently being offered. The proposed program will be administered by the Department of Electrical and Computer Engineering in the Batten College of Engineering & Technology and is to be initiated by Fall 2025.

The proposed M.S. ECE degree will prepare students develop leadership roles careers in industry, government, research organizations, and educational institutions. Graduates with the proposed ECE degree will be able to make original contributions that help society in the grand challenges that we are facing and will face, including in autonomous and connected systems, smart cities, intelligent manufacturing, and smart materials. The program will have three options, thesis, project, and course, each of which has 16 credits core courses to expose the students to foundational tools and the remaining courses will be selected in coordination between the Graduate Program Director and a research advisor to meet the needs of the ECE degree.

## B. Institutional Mission

The mission of the institution states: “Old Dominion University, located in the City of Norfolk in the metropolitan Hampton Roads region of coastal Virginia, is a dynamic public research institution that serves its students and enriches the Commonwealth of Virginia, the nation and the world through rigorous academic programs, strategic partnerships, and active civic engagement.” The Master of Science in Electrical and Computer Engineering aligns with this mission by (1) offering a robust curriculum that trains individuals in the field of Electrical and Computer Engineering, (2) addressing the critical shortage of employees and managers in the electrical and computer engineering workforce, (3) strengthening ODU’s commitment to contributing to the economy and workforce of the Hampton Roads region and the Commonwealth of Virginia, and (4) enhancing the partnerships that ODU has developed throughout the region.

## C. Delivery Format

The courses of the proposed M.S. ECE degree will be available in both online and on campus formats. Online course access will be through Canvas, the University’s course management system. The courses will be taught by an ECE faculty in front of students. All assignment submissions and other course management actions can take place in Canvas. Faculty-student interaction is available via email, phone, in-person meetings, and Zoom-interface meetings.

Faculty members who teach in the web-based format are experienced and can be assisted by ODU’s Division of Distance Learning and the Center for Faculty Development. If necessary, instructors can be trained to become effective instructors and to develop their courses for online and on campus delivery.

Students in this doctoral program will be expected to work at least part-time on campus to complete the research for their degree. To this end, ODU has made significant investments in the creation of state-of-the-art infrastructure and laboratories, including

- Applied Plasma Technology Laboratory (APTL)
- CAVE Automated Virtual Environment (CAVE)
- Collaborative Autonomous Systems Laboratory
- Cybersecurity, Communications & Networking Innovation (CCNI) Laboratory
- Gene Therapy and Regenerative Medicine Laboratory
- Machine Intelligence & HR Communications Laboratory
- Medical Simulations Laboratory
- Plasma Engineering & Medicine Institute (PEMI)
- Systems Research Laboratory
- Virginia Institute for Photovoltaics (VIPV)
- Vision Lab
- Virginia Institute for Vision Analysis (VIVA)

In addition, the department has several faculty members with research labs at the Applied Research Center (ARC) at the Jefferson National Laboratory, at the Frank Reidy Center for Bioelectronics, at the Center for Bioelectronics and at the Virginia Modeling, Analysis, and Simulation Center (VMASC).

## D. Admission Criteria

Applicants are expected to hold a B.S. degree in electrical engineering (EE) or computer engineering (CpE) from an accredited institution. Applicants are also expected to have a minimum grade point average of 3.0 (on a 4.0 scale) in both the baccalaureate major area (EE or CpE) and overall. Applicants with a GPA below a 3.0 may be considered for provisional admission, which may require additional prerequisite courses in addition to the graduate degree requirements. The applications are submitted through the Office of Admissions of Old Dominion University. Together with the completed application form, two letters of recommendation from former instructors or employment supervisors, transcripts from all colleges and universities attended, GRE scores, a resume, and a personal statement of objectives are required. TOEFL scores are also required for international applicants. Applicants with academic degrees in areas other than electrical and computer engineering will be considered. Those with degrees in math, physics, computer science, or other engineering fields are encouraged to apply. The linked Bachelor's/Master's degree program in the Frank Batten College of Engineering and Technology at Old Dominion University is designed to provide an opportunity for exceptionally qualified engineering undergraduate students to obtain both a bachelor's and a master's degree in Electrical and Computer Engineering. Typically undergraduate students apply at the end of their junior year for admission to the linked programs.

Accepted students from disciplines other than EE or CpE are required to complete a number of leveling courses to meet prerequisites for graduate studies. All students are required to have one year of college chemistry and one year of calculus-based college physics in addition to Calculus III and Differential Equations courses. Students at Old Dominion University may complete the leveling requirement by earning a minor in electrical or computer engineering with a GPA of 3.0 or greater. Students that have not earned a minor need to meet with the graduate program director to prepare a course plan and determine which pre-requisite courses are needed. In general, three to four leveling courses are needed and they are chosen from the following lists.

List of Possible Courses to Meet the Leveling Requirement

| | | |
|---|---|---|
| ECE 202 | Circuit Analysis II | 3 Credits |
| ECE 241 | Fundamentals of Computer Engineering | 4 Credits |
| ECE 302 | Linear System Analysis | 3 Credits |
| ECE 303 | Introduction to Electrical Power | 3 Credits |
| ECE 304 | Probability, Statistics, and Reliability | 3 Credits |
| ECE 313 | Electronic Circuits | 4 Credits |
| ECE 323 | Electromagnetics | 3 Credits |
| ECE 332 | Microelectronic Materials and Processes | 3 Credits |
| ECE 341 | Digital System Design | 3 Credits |
| ECE 346 | Microcontrollers | 3 Credits |
| ECE 381 | Introduction to Discrete-time Signal Processing | 3 Credits |

Students interested in taking computer engineering graduate courses may need to take additional leveling computer science courses as indicated below.

List of Possible Computer Science Courses to Meet the Leveling Requirements

| | | |
|---|---|---|
| CS 350 | Introduction to Software Engineering | 3 Credits |
| CS 361 | Data Structures and Algorithms | 3 Credits |
| CS 381 | Introduction to Discrete Structures | 3 Credits |

## E. Curriculum

The M.S. degree requires a minimum of 31 credit hours of graduate study. The program offers three options.

- The M.S. degree thesis option requires a minimum of 25 credit hours of courses (including a 1 credit hour Graduate Seminar) and 6 credit hours of thesis along with the oral thesis defense examination.
- The M.S. degree project option requires a minimum of 28 credit hours of courses (including a 1 credit Graduate Seminar) and 3 credit hours of a Master's project course (ECE 698) that includes an oral defense examination.

- The M.S. degree course option requires a minimum of 31 credit hours of courses (including a 1 credit Graduate Seminar) and a written comprehensive examination at the end of the course work.

**<u>Curriculum for Thesis Students</u>**

**Core Course – 16 credit hours**
ECE 558 Instrumentation (3 cr)
ECE 561 Automatic Control Systems (3 cr)
ECE 601 Linear Systems (3 cr)
ECE 611 Numerical Methods in Engineering Analysis **(**3 cr)
ECE 612 Digital Signal Processing I **(3 cr)**
ECE 731 Graduate Seminar (1 cr)

**Electives – 9 credit hours**

**Thesis – 6 credit hours**
Students will repeat this course as needed until minimum credit hours are fulfilled.
ECE 699 Thesis (1-3 cr)

**Additional requirements**
Students are required to write and defend in public their thesis successfully.

**Total credit hours – 31 credits**

**<u>Curriculum for Non-Thesis Students</u>**

**Core Course – 16 credit hours**
ECE 558 Instrumentation (3 cr)
ECE 561 Automatic Control Systems (3 cr)
ECE 601 Linear Systems (3 cr)
ECE 611 Numerical Methods in Engineering Analysis **(**3 cr)
ECE 612 Digital Signal Processing I **(3 cr)**
ECE 731 Graduate Seminar (1 cr)

**Electives – 12 credit hours**

**Master's Project (Capstone) – 3 credit hours**
ECE 698 Master's Project (3 cr)

**Total credit hours – 31 credits**

**<u>Curriculum for Course-Option Students</u>**

**Core Course – 16 credit hours**
ECE 558 Instrumentation (3 cr)

ECE 561 Automatic Control Systems (3 cr)
ECE 601 Linear Systems (3 cr)
ECE 611 Numerical Methods in Engineering Analysis **(**3 cr)
ECE 612 Digital Signal Processing I **(3 cr)**
ECE 731 Graduate Seminar (1 cr)

**Electives – 15 credit hours**

**Additional Requirements**
Written Comprehensive Exam

**Total credit hours – 31 credits**

Appendix A provides sample schedules for students with course, thesis, and project options. Course descriptions may be fund in Appendix B.

## F. Time to Degree

A full-time student will be able to complete the M.S. in ECE in one and half calendar years. Students who wish to do so will be required to complete 12 credit hours in fall semester and 13 credit hours in spring semesters (total of 25 credit hours) and 6 credit hours in the summer. Part-time students will complete the degree in approximately 2.5 years.

## G. Faculty Resources

Twenty-seven faculty members holding tenure-track or tenured positions in the department of Electrical and Computer Engineering have credentials to serve as the project advisor for M.S. students with the project option and the committee chair in thesis committee for M.S. students with the thesis option. M.S. students can also take graduate courses outside ECE. The none-ECE courses are taken in : College of Sciences (Computer Science; Mathematics & Statistics; Physics; Biological Sciences) and the Batten College of Engineering and Technology (Mechanical & Aerospace Engineering; Engineering Management and Systems Engineering).

The faculty have breadth and depth in areas of electrical and computer engineering, ranging from system to physical electronics, from power to renewable energy, and from fundamental signal processing to modeling, simulation, cybersecurity engineering. Combined, they have an extensive record of scholarship. During the past three years they disseminated over 230 peer-reviewed journal publications and over 150 peer-reviewed conference papers in electrical and computer fields. The ECE department has been ranked in the top 30 percent nationally by the National Science Foundation for research expenditures. Faculty members serving as Principal Investigators currently have 145 active research grants that have been awarded over $28,000,000 from prestigious organizations such as the National Science Foundation, Department of Homeland Security, Department of Defense, National Security Agency, Air Force Research Laboratory, and Department of Energy.

Abbreviated CVs for existing full-time faculty members can be found in Appendix C.

## H. Student Learning Assessment

The goal of this graduate level, M.S. program is to prepare its graduates to establish themselves as successful professionals in mid-level engineering positions in industry or government setting - by conducting themselves in a responsible, professional, and ethical manner.
M.S. students will be evaluated throughout the program using formative assessments, such as, tests, cases studies, capstone project (M.S. with project option), comprehensive exam (M.S. with course option), thesis (M.S. with thesis option), and presentations. Student learning outcomes cover many of the technical and management competencies that are required for the area of electrical and computer engineering.

1. Communicate in writing their understanding of electrical and computer engineering problems and solutions in a cohesive and well-structured manner;
2. Integrate principles and methods from a variety of disciplines to develop and implement best practices to solve electrical and computer engineering complexities;
3. Orally communicate their understanding of electrical and computer engineering, and explain decisions in cohesive and well-structured presentations to both technical and non-technical audience; and
4. Demonstrate and assume positions of professional leadership in both industry and government setting as well as successfully pursue a doctoral degree in their specialty area if they so desire.

1. as successful faculty members if they choose to join academia.

M.S. Students' learning outcomes assessment approach:

| Learning Outcomes | M.S. with Thesis Option | M.S. with Course Option | M.S. with Project Option |
|---|---|---|---|
| 1. Advanced Knowledge: Graduates will be able to apply advanced knowledge electrical and computer engineering to their chosen area of expertise in (1) systems, (2) signal and image processing, (3) physical | Thesis (ECE 699): The students' Master's Committee will assess the applicable outcomes based on the Master's Thesis and determine the student's ability by using the "rubrics" developed for this outcome. | Comprehensive Exam: The graduate committee will assess this outcome based on performance on the Master comprehensive examination. | Master Project (ECE 698): The students' project advisor and graduate program director will assess this outcome based on performance on the Master project report by using the "rubrics" developed for this outcome |

| | | | |
|---|---|---|---|
| electronics or (4) computer engineering | | | |
| 2. Problem Solving Skills: Graduates will be able to identify and formulate an advanced level electrical and computer engineering problem, to collect and analyze the relevant data and to develop a solution. | Thesis (ECE 699): The students' Master's Committee will assess the applicable outcomes based on the Master's Thesis and determine the student's ability by using the "rubrics" developed for this outcome. | Comprehensive Exam: The graduate committee will assess this outcome based on performance on the Master comprehensive examination. . | Master Project (ECE 698): The students' project advisor and graduate program director will assess this outcome based on performance on the Master Project report by using the "rubrics" developed for this outcome. |
| 3. Written Communication Skills: Graduates will be able to analyze electrical and computer engineering ideas and technical material such as mathematical equations and data analysis in writing | Thesis (ECE 699): The students' Master's Committee will assess the applicable outcomes based on the Master's Thesis and determine the student's ability by using the "rubrics" developed for this outcome. | a. Comprehensive Exam: The graduate committee will assess this outcome based on performance on the Master comprehensive examination b. Course Report: Graduate program director will assess student's course project report in student's chosen graduate courses by using the "rubrics" developed for this outcome. | Master Project (ECE 698): The students' project advisor and graduate program director will assess this outcome based on performance on the Master Project report by using the "rubrics" developed for this outcome. |
| 4. Verbal/Oral Communication Skills: Graduates will be able to explain electrical and computer engineering problems, methodologies, and related results using both verbal and | Thesis (ECE 699): The students' Master's Committee will assess the applicable outcomes based on the Master's Thesis defense and determine the student's ability by using the "rubrics" | Course Project Presentation: A course presentation is prepared by a student on a topic assigned by the class instructor. Questions directly related to assessment are placed in the assignments and/or | Master Project (ECE 698): The students' project advisor and graduate program director will assess this outcome based on performance on the Master Project presentation by using the "rubrics" |

| | | | |
|---|---|---|---|
| visual presentation skills | developed for this outcome. | examinations in a course. The course instructor evaluates the student responses to these questions to determine their ability level, with respect to the Outcomes, by using the "rubrics" developed for this outcome. | developed for this outcome. |
| 5. Independent Research Skills: Graduates will be able to conduct independent research in (1) systems, (2) signal and image processing, (3) physical electronics, or (4) computer engineering | Thesis (ECE 699): The students' Master's Committee will assess the applicable outcomes based on the Master's Thesis and determine the student's ability by using the "rubrics" developed for this outcome. | None | None |

Appendix shows rubric to evaluate those outcomes. Appendix shows the comprehensive exam (M.S. with course option) guidelines.

## I. Employment Skills

The M.S. program in Electrical and Computer Engineering will provide a continuously improving learning environment to its students while maintaining high ethical, multicultural, and global standards. The master's program stresses both theoretical and practical aspects of Electrical and Computer Engineering by combining the teaching and research expertise of the ECE faculty with additional research resources in the Hampton Roads area through department labs and university centers/institutes. The first goal of this M.S. program is to prepare its graduates so they will be able to establish themselves as successful professionals in mid-level engineering positions in industry or government - by conducting themselves in a responsible, professional, and ethical manner. Graduates are employed as electrical and computer engineers supporting industries like automotive, manufacturing, systems integration, shipbuilding, aerospace, defense, telecommunications, etc. They are also employed as researchers by private research and development labs or by federally funded organizations (e.g., Jefferson Lab, NASA, or the Naval Research Laboratories). The second goal of M.S. program is to prepare its graduates so they will be able to demonstrate and assume positions of professional leadership in both industry and government. The third goal of this M.S. program is to prepare its graduates and encourage them to successfully pursue a doctoral degree in their specialty area if they so desire.

Graduates of the proposed M.S. in ECE will have the skills and abilities needed for employment and workplace competencies in the field of electrical and computer engineering. Specifically, they will have the ability to:

- Graduates will possess skills and competencies in technical aspects of electrical and computer engineering fields, including systems, signal and image processing, physical electronics, computer engineering, and cybersecurity engineering.
- Graduates will analyze and solve practical electrical and computer engineering problems.

## J. Relationship to Existing Programs

The existing program at ODU is M.S. in General Engineering with a concentration in Electrical and Computer Engineering. The proposed program is not an expansion of an existing program. The proposed program is a standalone program with a new focus on Electrical and Computer Engineering. No degree programs will be compromised or closed as a result of the initiation and operation of the proposed degree program.

Part II: Justification for the Proposed Program

## A. Response to Current Needs (Specific Demand)

The Electrical and Computer Engineering CIP Code 14.4701 was introduced in 2020. Since 2020, 35 institutions have adopted the new CIP code. For example, the Rochester Institute of Technology and the University of Michigan adopted the new CIP code and started offering doctoral degrees in electrical and computer engineering. ODU would be the first university in Virginia to offer graduate degrees in electrical and computer engineering to meet current and future needs.

Shortage of Qualified Electrical and Computer Engineers for New Market Opportunities and Global Competitiveness Advanced Technology in USA

The proposed degree program will prepare students for research and industry careers throughout the Commonwealth of Virginia. The additional training of these students will be sought by employers in southwest, southeast, central, and northern Virginia. For example, HII Newport News Shipbuilding values students with a master's degree that are proficient in controls and computer networks. Manufacturing and companies focusing on data analytics will also benefit from our graduates.

According to the U.S. Bureau of Labor Statistics (BLS), two occupations long associated with innovation – electrical and electronics engineering – have all but stalled in their growth. The slow rate of growth in most manufacturing sectors is getting much of the blame for the stall in this occupation. This bleak view of the field is in direct contrast with industry claims that the United States has a massive shortage of skilled electrical engineers. American companies maintain that this is not an issue of declining demand, but rather one of declining investment in U.S. workers in favor of lobbying Congress for access to inexpensive foreign labor. Some observers claim that the demand for American electrical engineers would improve if the U.S. insisted that rockets that launch astronauts, satellites, weather, and GPS equipment were made in the U.S. The BLS predicts that most opportunities for electrical and electronics engineers will be with engineering service firms, as companies seek to reduce costs by contracting. Electrical engineers familiar with developing technologies in the areas of solar arrays, semiconductors, and communications will be best positioned to find jobs[1,].

According to a CNBC report[2], the software developer (one field of computer engineering) shortage will be alarming in 2022. According to the U.S. Bureau of Labor Statistics (BLS)[3], by 2030, the number of software job vacancies would rise by almost 22%. The average growth rate of software developers in the USA is only 8% right now, and that clearly emphasizes there is already an overwhelming and severe shortage of skilled workers. The talent shortfall starts with college graduates and advanced professionals in the fields of science, technology, engineering and mathematics (STEM). While a shortage of STEM workers will not stop a company's day-to-day operations, it can hamper the pace of growth for the whole industry and, subsequently, have an impact on the competitiveness of entire countries or regions[4].

The proposed degree program will prepare students for research and industry careers throughout the Commonwealth of Virginia. The additional training of these students will be sought by employers in southwest, southeast, central, and northern Virginia. For example, HII Newport News Shipbuilding values students with a master's degree that are proficient in controls and computer networks. Manufacturing and companies focusing on data analytics will also benefit from our graduates.

[1]The job market for electrical engineers in the United states, CareerExplorer, http://www.careerexplorer.com/careers/electrical-engineer/job-market/#whats-the-supply.
[2]The US has nearly 1 million open IT jobs—here's how much it can pay off to switch industries into tech, CNBC, http://www.cnbc.com/2019/11/06/how-switching-careers-to-tech-could-solve-the-us-talent-shortage.html.
[3]Computer Programmers, U.S. Bureau of Labor Statistics, http:// www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm.
[4]Engineering Talent Shortage Now Top Risk Factor, Semiconductor Engineering. http:// Engineering Talent Shortage Now Top Risk Factor (semiengineering.com)

## B. Employment Demand

The proposed M.S. in ECE responds to the need for electrical and computer professionals in the Commonwealth of Virginia, the nation, and the world. In recent U.S. Bureau of Statistics, employment of computer and information research scientists is projected to grow 20 percent from 2020 to 2030, much faster than the average for all occupations[1]. About 9,700 openings for computer programmers are projected each year, on average, over the decade[2]. Overall employment of electrical and electronics engineers is projected to grow 7 percent from 2020 to 2030, about as fast as the average for all occupations[3]. "There are more computers on the manufacturing floor than machine tools and other types of equipment," said Judy Marks, CEO of Siemens USA[4]. More and more factory jobs now demand education, technical know-how or specialized skills. And many of the workers set adrift from low-tech factories lack such qualifications[4]. Computer and information research scientists typically need a master's or higher degree in computer related field, such as electrical and computer engineering[5]. Focusing on cutting edge education and training will be essential for Virginia's and U.S. high technology workforce and economic development as occupations in the electrical and computer industry are highly in demand and among the fastest growing in the economy. The proposed degree program will contribute to addressing such needs by preparing students to understand electrical and computer engineering principles and develop more innovative and advanced systems. Graduates will become the next generation in the high technology workforce to safeguard U.S. the leadership in technology.

[1] Computer and Information Research Scientists, U.S. Bureau of Labor Statistics, http:// www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm.
[2] Computer Programmers, U.S. Bureau of Labor Statistics, http:// www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm.
[3] Electrical and Electronics Engineers, U.S. Bureau of Labor Statistics, http;// www.bls.gov/ooh/architecture-and-engineering/electrical-and-electronics-engineers.htm.

[4] Lots of High-Tech factory Jobs in U.S., but Skilled Workers Are lacking, The Seattle Times, http:// www.seattletimes.com/business/high-tech-us-plants-offer-jobs-even-as-the-laid-off-struggle/

[5] U. S. Bureau of Labor Statistics, http://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-4

**Labor Market Information: Bureau of Labor Statistics, 2021 -2031 (10-Yr)**

| Occupation | Base Year Employment | Projected Employment | Total % Change and #s | Typical Entry Level Education |
|---|---|---|---|---|
| Electrical and Electronics Engineer | 303,800 | 313,600 | 3%, 9,800 | Bachelor's |
| Computer hardware engineer | 76,900 | 80,600 | 5%, 3,700 | Bachelor's |
| Computer and information research scientist | 33,500 | 40,600 | 21%, 7,100 | Master's |
| Computer network architects | 174,800 | 182,300 | 4%, 7500 | Bachelor's |
| Computer systems analyst | 538,800 | 589,700 | 9%, 50,900 | Bachelor's |

**Labor Market Information: Virginia Employment Commission, 2020 -2030 (10-Yr)**

| Occupation | Base Year Employment | Projected Employment | Total % Change and #s | Annual Change # | Education |
|---|---|---|---|---|---|
| Electrical Engineer | 6155 | 6666 | 8.3%, 511 | 51 | Bachelor's |
| Electronics Engineers, Except Computer | 3981 | 4234 | 6.3%, 253 | 25 | Bachelor's |
| Computer and Information Systems Managers | 15422 | 17107 | 10.9%, 1685 | 168 | Bachelor's |
| Computer Science Teachers, Postsecondary | 1668 | 1843 | 10.4%, 175 | 18 | Not applicable |

## C. Student Demand

Our draft student demand survey is attached as Appendix H which was sent out to ODU ECE majors with Junior, Senior, and MS standing (i.e., those likely already thinking about potential graduate programs) and students outside ODU.

## D. Duplication

No university in the Commonwealth of Virginia offers a M.S. degree in Electrical and Computer Engineering. The following tables provide data for similar but not equivalent degrees.

M.S. degree:

| Engineering, General (CIP Code: 14.0101) | | | | |
|---|---|---|---|---|
| Institution | Degree | Program Name | Enrollment | Degrees Awards |
| Virginia Commonwealth University | M.S. | Engineering | Fall 2021: 17<br>Fall 2020: 13<br>Fall 2019: 14<br>Fall 2018: 23<br>Fall 2017: 26 | Year 2021: 5<br>Year 2020: 8<br>Year 2019: 12<br>Year 2018: 11<br>Year 2017: 8 |
| Old Dominion University | M.S. | Engineering | Fall 2021: 331<br>Fall 2020: 300<br>Fall 2019: 312<br>Fall 2018: 322<br>Fall 2017: 316 | Year 2021: 81<br>Year 2020: 106<br>Year 2019: 100<br>Year 2018: 97<br>Year 2017: 100 |

| Electrical and Electronics Engineering (CIP Code: 14.1001) | | | | |
|---|---|---|---|---|
| Institution | Degree | Program Name | Enrollment | Degrees Awards |
| George Mason University | M.S. | Electrical and Computer Engineering | Fall 2021: 64<br>Fall 2020: 66<br>Fall 2019: 74<br>Fall 2018: 86<br>Fall 2017: 85 | Year 2021: 26<br>Year 2020: 29<br>Year 2019: 26<br>Year 2018: 26<br>Year 2017: 26 |
| University of Virginia | M.S./M.E. | Electrical Engineering | Fall 2021: 39<br>Fall 2020: 30<br>Fall 2019: 25<br>Fall 2018: 29<br>Fall 2017: 40 | Year 2021: 21<br>Year 2020: 8<br>Year 2019: 13<br>Year 2018: 14<br>Year 2017: 29 |
| Virginia Tech | M.S./M.E. | Electrical Engineering | Fall 2021: 107<br>Fall 2020: 93<br>Fall 2019: 110<br>Fall 2018: 103<br>Fall 2017: 125 | Year 2021: 54<br>Year 2020: 57<br>Year 2019: 63<br>Year 2018: 63<br>Year 2017: 72 |
| Norfolk State University | M.S. | Electronics Engineering | Fall 2021: 30<br>Fall 2020: 25 | Year 2021: 15<br>Year 2020: 7 |

| | | | | |
|---|---|---|---|---|
| | | | Fall 2019: 26<br>Fall 2018: 21<br>Fall 2017: 10 | Year 2019: 6<br>Year 2018: 11<br>Year 2017: 18 |

| Computer Engineering, General (CIP Code: 14.0901) | | | | |
|---|---|---|---|---|
| Institution | Degree | Program Name | Enrollment | Degrees Awards |
| George Manson University | M.S. | Computer Engineering | Fall 2021: 50<br>Fall 2020: 40<br>Fall 2019: 41<br>Fall 2018: 38<br>Fall 2017: 61 | Year 2021: 21<br>Year 2020: 15<br>Year 2019: 23<br>Year 2018: 25<br>Year 2017: 23 |
| University of Virginia | M.S./M.E | Computer Engineering | Fall 2021: 28<br>Fall 2020: 20<br>Fall 2019: 33<br>Fall 2018: 49<br>Fall 2017: 44 | Year 2021: 15<br>Year 2020: 27<br>Year 2019: 27<br>Year 2018: 27<br>Year 2017: 18 |
| Virginia Tech | M.S./M.E. | Computer Engineering | Fall 2021: 159<br>Fall 2020: 115<br>Fall 2019: 109<br>Fall 2018: 104<br>Fall 2017: 113 | Year 2021: 61<br>Year 2020: 49<br>Year 2019: 57<br>Year 2018: 61<br>Year 2017: 55 |

**Virginia Commonwealth University (VCU)**

Similarities to ODU

1. Provide thesis (30 credits) and non-thesis option (30 credits).
2. The degree is designated as general engineering with a concentration in electrical and computer engineering.
3. It covers disciplines related to electrical and computer engineering.

Differences from ODU

1. For the non-thesis option, it only has the course option.
2. For the thesis option, it only needs 30 credits and does not require additional 1 credit graduate seminar. It divides course works into two portions, 12 credits concentration component focusing on a specific field of engineering and serving as the student's primary engineering discipline, and 12 credits option electives in either engineering or science with approval of the student's adviser.
2. For the non-thesis option, it divides course works into two portions, 15 credits concentration component focusing on a specific field of engineering and serving as the student's primary engineering discipline, and 15 credits option electives in either engineering or science with approval of the student's adviser. It does not have the comprehensive exam.

**George Mason University (GMU)**

Similarities to ODU

1. Provide thesis and non-thesis option.

2. It covers disciplines related to electrical and computer engineering, but in two separate degrees, Electrical Engineering and Computer Engineering.

Differences from ODU
1. It provide two separate degrees, Electrical Engineering and Computer Engineering, to focus on electrical and computer engineering disciplines, respectively.
2. For the non-thesis option, it only has the course option, namely scholarly paper option. It does not require the comprehensive exam as part of the requirement, but a written report.
3. No core courses

**Virginia Tech (VT)**
Similarities to ODU
1. Provide thesis, course, and project options (30 credits).
2. It covers disciplines related to electrical and computer engineering, but in two separate degrees, Electrical Engineering and Computer Engineering.

Differences from ODU
1. It provide two separate degrees, Electrical Engineering and Computer Engineering, to focus on electrical and computer engineering disciplines, respectively.
2. For the course option, it does not require the comprehensive exam.
3. It does not require 1 credit seminar.
4. No core courses

**University of Virginia (UVA)**
Similarities to ODU
1. Provide thesis (31 credits) and non-thesis option (31 credits).
2. It requires 1 credit seminar.
3. It covers disciplines related to electrical and computer engineering.

Differences from ODU
1. It provide two separate degrees, Electrical Engineering and Computer Engineering, to focus on electrical and computer engineering disciplines, respectively.
2. For non-thesis option, it only has course option. However, it does not have a comprehensive examination for the course option students.
3. No core courses

**Norfolk State University (NSU)**
Similarities to ODU
M.S.
It has thesis and non-thesis option (master project)

Differences from ODU
M.S.
1. It is focused on two disciplines, Biomedical / Modeling & Simulation Track and Microelectronics and Photonics Track.
2. No courses

**Projected enrollment**:

| Year 1 | | Year 2 | | Year 3 | | Year 4 | | | Year 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2025-2026** | | **2026-2027** | | **2027-2028** | | **2028-2029** | | | **2029-2030** | | |
| HDCT ______ | FTES ______ | HDCT ______ | FTES ______ | HDCT ______ | FTES ______ | HDCT ______ | FTES ______ | GRAD ______ | HDCT ______ | FTES ______ | GRAD ______ |

Assumptions:
Retention percentage: 80%
Part-time students: 20%; Full-time students: 80%
Expected time to graduation for full-time: 5 years; and part-time: 7 years
Number of credit hours per semester for full-time: 9; and for part-time: 3-6

Part IV: Projected Resource Needs for the Proposed Program

**Resource Needs**

**Full-Time Faculty**
Twenty-seven full-time faculty members who are either tenured or on a tenure track will teach the core course curriculum in the Ph.D. in Electrical and Computer Engineering program, with an additional Two faculty teaching associated electives for a total of twenty-nine full-time program faculty.

**Part-Time Faculty**
No part-time faculty members are required to launch and sustain the proposed program.

**Adjunct Faculty**
No adjunct faculty members are required to initiate and sustain the proposed program.

**Graduate Assistants**
No graduate assistants are required to initiate and sustain the proposed program.

**Classified Positions**
No classified position is requested to initiate and sustain the proposed program.

**Targeted Financial Aid**
No targeted financial aid is required to launch and sustain the proposed program.

**Library**

No new library resources are required to launch and sustain the proposed program. The University Libraries has a strong collection in the Electrical and Computer Engineering. Many current journals are found in the online databases, and the library has a responsive interlibrary loan program for resources outside of the current collection. The Department of Electrical and Computer Engineering has an annual allowance for books or journals.

**Telecommunications**
No new telecommunication resources are needed to initiate and sustain the proposed program.

**Equipment (including computers)**
No new equipment resources are needed to initiate and sustain this proposed program.

**Space**
No additional space is needed to initiate and sustain this proposed program.

**Other Resources (specify)**
No new resources will be required to launch or operate the proposed Master of Science in Cybersecurity.

**Funds to Initiate and Operate the Degree Program**

| Cost and Funding Sources to Initiate and Operate the Program | | | |
|---|---|---|---|
| | Informational Category | Program Initiation Year 2025-2026 | Program Full Enrollment Year 2028-2029 |
| 1 | Projected Enrollment (Headcount) | 56 | 75 |
| 2 | Projected Enrollment (FTE) | 38 | 56 |
| 3 | Projected Enrollment Headcount of In- State Students | $16,369 (in-state) $38,595 (out-of-state) | $18,949 (in-state) $44,679 (out-of-state) |
| 4 | Projected Enrollment Headcount of Out- of-State Students | $1,050,020 | $1,627,015 |
| 5 | Estimated Annual Tuition and E&G Fees for In-state Students in the Proposed Program | | |
| 6 | Estimated Annual Tuition and E&G Fees for Out-of-State Students in the Proposed Program | | |
| 7 | Projected Total Revenue from Tuition and E&G Fees Due to the Proposed Program | | |
| 8 | Other Funding Sources Dedicated to the Proposed Program (e.g., grant, business entity, private sources) | $0.00 | $0.00 |

**Resource Needs: Parts A - D**

**Part A: Answer the following questions about general budget information.**

- Has or will the institution submit an addendum budget request to cover one-time costs? Yes ________ No ___X___
- Has or will the institution submit an addendum budget request to cover operating costs? Yes No X

- Will there be any operating budget requests for this program that would exceed normal operating budget guidelines (for example, unusual faculty mix, faculty salaries, or resources)? Yes _______ No __X__
- Will each type of space for the proposed program be within projected guidelines? Yes __X__ No _______
- Will a capital outlay request in support of this program be forthcoming? Yes _______ No __X__

**Part D: Certification Statement(s)**

The institution will require additional state funding to initiate and sustain this program.

________ Yes ____________________________________________
Signature of Chief Academic Officer

___X___ No ____________________________________________
Signature of Chief Academic Officer

**Secondary Certification.**

If resources are reallocated from another unit to support this proposal, the institution will **not** subsequently request additional state funding to restore those resources for their original purpose.

___X___ Agree ____________________________________________
Signature of Chief Academic Officer

________ Disagree ____________________________________________
Signature of Chief Academic Officer

**APPENDICES**

# APPENDIX A
# PLAN OF STUDY

Sample Plan of Study for Full-Time Students

Thesis Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 601 Linear Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| TOTAL 10 credits | | |
| **Spring I** | | |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 19 credits | | |
| **Summer I** | | |
| Elective Courses | 3 | Elective |
| TOTAL 3 credits | | |
| **Fall II** | | |
| Elective Courses | 3 | Elective |
| ECE 699 | 6 | Thesis |
| TOTAL 9 credits | | |

Total Required for Degree—31 credits

Course Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 601 Linear Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| TOTAL 10 credits | | |
| **Spring I** | | |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 19 credits | | |
| **Summer I** | | |
| Elective Courses | 3 | Elective |
| TOTAL 3 credits | | |
| **Fall II** | | |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| TOTAL 9 credits | | |

Total Required for Degree—31 credits

Project Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 601 Linear Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| TOTAL 10 credits | | |
| **Spring I** | | |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 19 credits | | |
| **Summer I** | | |
| Elective Courses | 3 | Elective |
| TOTAL 3 credits | | |
| **Fall II** | | |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| ECE 698 | 3 | Capstone |
| TOTAL 9 credits | | |

Total Required for Degree—31 credits

Sample Plan of Study for Part-Time Students
Thesis Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| | | |
| TOTAL 7 credits | | |
| **Spring I** | | |
| ECE 601 Linear Systems | 3 | Core |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| TOTAL 6 credits | | |
| **Fall II** | | |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Spring II** | | |
| Elective Courses | 3 | Elective |

| | | |
|---|---|---|
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Fall III** | | |
| ECE 699 | 6 | Thesis |
| TOTAL 6 credits | | |

Total Required for Degree—31 credits

Course Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| | | |
| TOTAL 7 credits | | |
| **Spring I** | | |
| ECE 601 Linear Systems | 3 | Core |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| TOTAL 6 credits | | |
| **Fall II** | | |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Spring II** | | |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Fall III** | | |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |

Total Required for Degree—31 credits

Project Option

| Course | Credits | Category |
|---|---|---|
| **Fall I** | | |
| ECE 558 Instrumentation | 3 | Core |
| ECE 561 Automatic Control Systems | 3 | Core |
| ECE 731 Graduate Seminar | 1 | Core |
| | | |
| TOTAL 7 credits | | |
| **Spring I** | | |

| | | |
|---|---|---|
| ECE 601 Linear Systems | 3 | Core |
| ECE 611 Numerical Methods in Engineering Analysis | 3 | Core |
| TOTAL 6 credits | | |
| **Fall II** | | |
| ECE 612 Digital Signal Processing I (3 Credit Hours) | 3 | Core |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Spring II** | | |
| Elective Courses | 3 | Elective |
| Elective Courses | 3 | Elective |
| TOTAL 6 credits | | |
| **Fall III** | | |
| Elective Courses | 3 | Elective |
| ECE 698 | 3 | Capstone |
| TOTAL 6 credits | | |

Total Required for Degree—31 credits

# APPENDIX B
# COURSE DESCRIPTIONS

## Core Courses

### ECE 558 Instrumentation (3 Credit Hours)

Computer interfacing using a graphical programming language with applications involving digital-to-analog conversion (DAC), analog-to-digital conversion (ADC), digital input output (DIO), Virtual Instrument System Architecture (VISA) and universal Service Bus (USB). Analysis of sampled data involving use of probability density function, mean and standard derivations, correlations, and the power spectrum.

### ECE 561 Automatic Control Systems (3 Credit Hours)

Analysis and design of control systems as found in automobiles and aircraft, autonomous vehicles, robots, and many other engineering systems. Time and frequency domain techniques such as root locus, Bode, Nyquist and state space techniques are utilized together with computer-aided analysis and design.

### ECE 601 Linear Systems (3 Credit Hours)

A comprehensive introduction to the analysis of linear dynamical systems from an input-output and state space point of view. Concepts from linear algebra, numerical linear algebra and linear operator theory are used throughout. Some elements of state feedback design and state estimation are also covered.

### ECE 611 Numerical Methods in Engineering Analysis (3 Credit Hours)

Course intended to provide graduate students in Electrical and Computer Engineering with a basic knowledge of numerical methods applied to engineering problem-solving process. The course includes the following topics: Introduction to computing (Matlab), Truncation errors and Taylor series, Numerical integration, Solution of non-linear equations, Least-Square regression, Interpolations, Ordinary and partial differential equations, and Finite difference methods. Applications to the area of electrical engineering.

### ECE 612 Digital Signal Processing I (3 Credit Hours)

This course will present the fundamentals of digital signal processing. Topics will include frequency domain analysis of discrete-time linear systems, sampling and reconstruction of signals, the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), and digital filter design and implementations. Practical applications and examples will be discussed. Problem solving using MATLAB is required.

### ECE 731 Graduate Seminar (1 Credit Hour)

Graduate seminar presentations concerning technical topics of current interest given by faculty and invited speakers.

## Elective Courses

### ECE 503 Power Electronics (3 Credit Hours)

Power electronics provides the needed interface between an electrical source and an electrical load and facilitates the transfer of power from a source to a load by converting voltages and currents from one form to another. Topics include: alternating voltage rectification, Pulse Width Modulation (PWM), DC converters (Buck, Boost, Buck-Boost, Cuk and SEPIC converters), negative feedback control in power electronics, isolated switching mode power supply, flyback and forward power supply, solid state power switches, AC inverter.

**ECE 504  Electric Drives  (3 Credit Hours)**
Electric drives efficiently control the torque, speed and position of electric motors. This course has a multi-disciplinary nature and includes fields such as electric machine theory, power electronics, and control theory. Topics include: switch-mode power electronics, magnetic circuit, DC motor, AC motor, Brushless DC motor, induction motor, speed control of induction motor, vector control of induction motor, stepper-motor.

**ECE 505  Power System Design & Analysis  (3 Credit Hours)**
This course covers basic power circuit analysis and introductory power system engineering and focuses on the transmission line design, power flow study, short circuit protection, and power distribution in electric power systems, followed by a survey of several applications and case studies.

**ECE 506  Computer Graphics and Visualization  (3 Credit Hours)**
The course provides a practical treatment of computer graphics and visualization with emphasis on modeling and simulation applications. It covers digital image and signal processing basics such as sampling and discrete Fourier transform, computer graphics fundamentals, visualization principles, and software architecture for visualization in modeling and simulation. Written communication and information literacy skills are stressed in this course.

**ECE 507  Introduction to Game Development  (3 Credit Hours)**
An introductory course focused on game development theory and modern practices with emphasis on educational game development. Topics include game architecture, computer graphics theory, user interaction, audio, high level shading language, animation, physics, and artificial intelligence. The developed games can run on a variety of computer, mobile, and gaming platforms.

**ECE 508  Fundamentals of Electric Vehicles  (3 Credit Hours)**
This course covers the fundamentals of electric vehicles and focuses on the components, power control, energy management, power train dynamics and other related topics in purely electric and hybrid electric vehicle systems, including a survey of several applications and case studies.

**ECE 509  Introduction to Distributed Simulation  (3 Credit Hours)**
An introduction to distributed simulation. Topics include motivation for using distributed simulation, distributed simulation architectures, time management issues, and distributed simulation approaches. Current standards for distributed simulation are presented.

**ECE 510  Model Engineering  (3 Credit Hours)**
The goal of this course is to develop understanding of the various modeling paradigms appropriate for capturing system behavior and conducting digital computer simulation of many types of systems. The techniques and concepts discussed typically include UML, concept graphs, Bayesian nets, Markov models, Petri nets, system dynamics, Bond graphs, etc. Students will report on a particular technique and team to implement a chosen system model.

**ECE 516  Cyber Defense Fundamentals  (3 Credit Hours)**
This course focuses on cybersecurity theory, information protection and assurance, and computer systems and networks security. The objectives are to understand the basic security models and concepts, learn fundamental knowledge and tools for building, analyzing, and attacking modern security systems, and gain hands-on experience in cryptographic algorithms, security fundamental principles, and Internet security protocol and standards.

**ECE 519  Cyber Physical System Security  (3 Credit Hours)**
Cyber Physical Systems (CPS) integrate computing, networking, and physical processes. The objectives of this course are to learn the basic concepts, technologies and applications of CPS, understand the fundamental CPS security challenges and national security impact, and gain hands-on experience in CPS infrastructures, critical vulnerabilities, and practical countermeasures.

**ECE 541  Advanced Digital Design and Field Programmable Gate Arrays  (3 Credit Hours)**
Course will present FPGA technologies and methods using CAD design tools for implementation of digital systems using FPGAs. Topics include advanced methods of digital circuit design including specification, synthesis, implementation and prototyping; managing multiple clock domains, static timing analysis, timing closure, system reset design, simulation, and optimization; troubleshooting using embedded logic analyzers and integrated development environments (IDEs). Practical system design examples include general purpose data processing, system on a chip (SOC) prototyping, hardware accelerators, and an introduction to domain specific architectures.

**ECE 543  Computer Architecture  (3 Credit Hours)**
An introduction to computer architectures. Analysis and design of computer subsystems including central processing units, memories and input/output subsystems. Important concepts include datapaths, computer arithmetic, instruction cycles, pipelining, virtual and cache memories, direct memory access and controller design.

**ECE 545  Introduction to Computer Vision  (3 Credit Hours)**
Overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation, and data processing method for computer vision applications. Hand-on projects will be introduced to better understand computer vision applications.

**ECE 550  Introduction to Machine Learning for Data Analytics Engineering  (3 Credit Hours)**

Machine Learning provides a practical treatment of design, analysis and implementation of algorithms, which learn from examples. Topics include multiple machine learning models: linear regression, logistic regression, neural networks, support vector machines, deep learning, Bayesian learning and unsupervised learning. Students are expected to use popular machine learning tools and algorithms to solve real data engineering problems.

**ECE 551 Communication Systems (3 Credit Hours)**
Fundamentals of communication systems engineering. Modulation methods including continuous waveform modulation (amplitude, angle). Design and analysis of modulation systems and performance in the presence of noise. Communication simulation exercises through computer experiments.

**ECE 552 Introduction to Wireless Communication Networks (3 Credit Hours)**
Introduction to current wireless network technologies and standards. The radio frequency spectrum and radio wave propagation models (pathloss, fading, and multipath). The radio link and link budgets. Modulation, diversity, and multiple access techniques. Wireless network planning and operation. Current and emerging wireless technologies (satellite systems, vehicular/sensor networks).

**ECE 553 Analysis for Modeling and Simulation (3 Credit Hours)**
An introduction to analysis techniques appropriate to the conduct of modeling and simulation studies. Topics include input modeling, random number generation, output analysis, variance reduction techniques, and experimental design. In addition, techniques for verification & validation are introduced.

**ECE 554 Introduction to Bioelectrics (3 Credit Hours)**
Covers the electrical properties of cells and tissues as well as the use of electrical and magnetic signals and stimuli in the diagnosis and treatment of disease. Typical topics to be covered include basic cell physiology, endogenous electric fields in the body, electrocardiography, cardiac pacing, defibrillation, electrotherapy, electroporation, electrotherapy in wound healing. In addition, ultrashort electrical pulses for intracellular manipulation and the application of plasmas to biological systems will be covered.

**ECE 555 Network Engineering and Design (3 Credit Hours)**
This course is an extension of ECE 355 into a semester long project. Emphasis is on gaining an understanding of networking design principles that entails all aspects of the network development life cycle. Topics include campus LAN models and design, VLANs, internetworking principles and design, WAN design, design of hybrid IP networks, differentiated vs. integrated services, traffic flow measurement and management.

**ECE 562 Introduction to Medical Image Analysis (MIA) (3 Credit Hours)**
Introduction to basic concepts in medical image analysis. Medical image registration, segmentation, feature extraction, and classification are discussed. Basic psychophysics, fundamental ROC analysis and FROC methodologies are covered.

**ECE 563  Design and Modeling of Autonomous Robotic Systems  (3 Credit Hours)**
This course focuses on autonomous robotics systems with emphasis on using modeling and simulation (M&S) for system level design and testing. Fundamental concepts associated with autonomous robotic systems are discussed. Course topics include: robotic control, architectures, and sensors as well as more advanced concepts such as error propagation, localization, mapping and autonomy. Design strategies that leverage M&S to accelerate the development and testing of sophisticated autonomous robotic algorithms for individual or teams of robots are covered.

**ECE 564  Biomedical Applications of Low Temperature Plasmas  (3 Credit Hours)**
This course is cross listed between ECE, BME and BIOL. It is designed to be taken by senior undergraduate students and first year graduate students. The course contents are multidisciplinary, combining materials from engineering and the biological sciences. The course covers an introduction to the fundamentals of non-equilibrium plasmas, low temperature plasma sources, and cell biology. This is followed by a detailed discussion of the interaction of low temperature plasma with biological cells, both prokaryotes and eukaryotes. Potential applications in medicine such as wound healing, blood coagulation, sterilization, and the killing of various types of cancer cells will be covered.

**ECE 570  Foundations of Cyber Security  (3 Credit Hours)**
Course provides an overview of theory, tools and practice of cyber security and information assurance through prevention, detection and modeling of cyber attack and recovery from such attacks. Techniques for security modeling, attack modeling, risk analysis and cost-benefit analysis are described to manage the security of cyber systems. Fundamental principles of cyber security and their applications for protecting software and information assets of individual computers and large networked systems are explored. Anatomy of some sample attacks designed to compromise confidentiality, integrity and availability of cyber systems are discussed.

**ECE 571  Introduction to Solar Cells  (3 Credit Hours)**
This course is designed to provide the fundamental physics and characteristics of photovoltaic materials and devices. A focus is placed on i) optical interaction, absorption, and design for photovoltaic materials and systems, ii) subsequent energy conversion processes in inorganic/organic semiconductor such as generation, recombination, and charge transport, and iii) photovoltaic testing and measurement techniques to characterize solar cells including contact and series resistance, open circuit voltage, short circuit current density, fill factor, and energy conversion efficiency of photovoltaic devices.

**ECE 572  Plasma Processing at the Nanoscale  (3 Credit Hours)**
The science and design of partially ionized plasma and plasma processing devices used in applications such as etching and deposition at the nanoscale. Gas phase collisions, transport parameters, DC and RF glow discharges, the plasma sheath, sputtering, etching, and plasma deposition.

**ECE 573  Solid State Electronics  (3 Credit Hours)**

The objective of this course is to understand basic semiconductor devices by understanding semiconductor physics (energy bands, carrier statistics, recombination and carrier drift and diffusion) and to gain an advanced understanding of the physics and fundamental operation of advanced semiconductor devices. Following the initial introductory chapters on semiconductor physics, this course will focus on the theory of p-n junctions, metal-semiconductor Schottky diodes, MOS capacitors, MOS field effect transistors (MOSFET) and bipolar junction transistors (BJTs).

**ECE 574 Optical Fiber Communication (3 Credit Hours)**
This course introduces seniors and first year graduates to the physics and design of optical fiber communication systems. The topics covered are: electromagnetic waves; optical sources including laser diodes; optical amplifiers; modulators; optical fibers; attenuation and dispersion in optical fibers; photodetectors; optical receivers; noise considerations in optical receivers; optical communication systems.

**ECE 575 Transportation Data Analytics (3 Credit Hours)**
This course presents the basic techniques for transportation data analytics. It will discuss statistical modeling, prominent algorithms, and visualization approaches to analyze both small- and large-scale data sets generated from transportation systems. Practices of using different data for various real-world traffic/transportation applications and decision making will also be discussed.

**ECE 583 Embedded Systems (3 Credit Hours)**
This course covers fundamentals of embedded systems: basic architecture, programming, and design. Topics include processors and hardware for embedded systems, embedded programming and real time operating systems.

**ECE 607 Machine Learning I (3 Credit Hours)**
Course provides a practical treatment of design, analysis, implementation and applications of algorithms. Topics include multiple machine learning models: linear models, neural networks, support vector machines, instance-based learning, Bayesian learning, genetic algorithms, ensemble learning, reinforcement learning, unsupervised learning, etc.

**ECE 623 Electromagnetism (3 Credit Hours)**
Review of electrostatic and magnetostatic concepts, time varying field, Maxwell's equations, plane wave propagation in various media, transmission lines, optical wave guides, resonant cavities, simple radiation systems, and their engineering applications.

**ECE 642 Computer Networking (3 Credit Hours)**
The course is based on the ISO (International Standard Organization) OSI (Open Systems Interconnection) reference model for computer networks. A focus is placed on the analysis of protocols at different layers, network architectures, and networking systems performance

analysis. Current topic areas include LANs, MANs, TCP/IP networks, mobile communications, and ATM.

**ECE 643 Computer Architecture Design (3 Credit Hours)**
Digital computer design principles. The course focuses on design of state-of-the-art computing systems. An emphasis is placed on superscalar architectures focusing on the pipelining and out-of-order instruction execution operations.

**ECE 648 Advanced Digital Design (3 Credit Hours)**
This course introduces methods for using high level hardware description language such as VHDL and/or Verilog for the design of digital architecture. Topics include top-down design approaches, virtual prototyping, design abstractions, hardware modeling techniques, algorithmic and register level design, synthesis methods, and application decomposition issues. Final design project is required.

**ECE 652 Wireless Communications Networks (3 Credit Hours)**
Fundamental concepts in wireless communication systems and networks: radio waveform propagation modeling (free-space, reflections and multipath, fading, diffraction and Doppler effects); physical and statistical models for wireless channels; modulation schemes for wireless communications and bandwidth considerations; diversity techniques; MIMO systems and space-time coding; multiuser systems and multiple access techniques (TDMA, FDMA. CDMA); spread spectrum and multiuser detection; introduction to wireless networking and wireless standards; current and emerging wireless technologies.

**ECE 667 Cooperative Education (1-3 Credit Hours)**
Student participation for credit based on academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and the Cooperative Education/Career Development Services program prior to the semester in which the work experience is to take place.

**ECE 695 Topics in Electrical or Computer Engineering (3 Credit Hours)**
This course will be offered as needed, depending upon the need to introduce special subjects to target specific areas of master's-level specializations in electrical or computer engineering.

**ECE 731 Graduate Seminar (1 Credit Hour)**
Graduate seminar presentations concerning technical topics of current interest given by faculty and invited speakers.

**ECE 742 Computer Communication Networks (3 Credit Hours)**
This is an advanced level course in data communications. A focus is placed on the analysis, modeling, and control of computer communication systems. Topics include packet switched networks, circuit switched networks, ATM networks, network programming, network control and performance analysis, network security, and wireless sensor networks.

**ECE 751 Computational and Statistical Methods in Biomedical Engineering (3 Credit Hours)**
This course covers the theoretical foundation and application of commonly used techniques in biomedical engineering. Topics include linear algebra, partial differential equations, regression analysis, applied probabilities, multivariate distributions, Bayesian statistics, hypothesis tests, multiple comparisons, ANOVA, solution of non-linear equations, numerical methods and optimization. Programming software will be used to perform simulations and analyze biomedical data.

**ECE 754 Advanced Bioelectrics (3 Credit Hours)**
Bioelectrics is a new field encompassing both the science and technology of applying electrical stimuli to biological systems. This course covers the pulsed power technology that is required to generate electrical stimuli as well as the biological responses they evoke in cells and tissues. Particular emphasis is placed on the medical applications of bioelectrics, including tumor ablation, gene electrotransfer, wound healing, decontamination with cold plasma, and treatment of cardiac arrhythmias.

**ECE 755 Biomembranes and Ion Channels (3 Credit Hours)**
This course will give an overview of the structure and dynamics of biomembranes, the ion channels that are embedded in them, and the electrical properties of biomembranes. Topics include molecular dynamics modeling of biomembranes, membrane damage and repair, ion channel dynamics and their experimental assessment using patch clamping, and excitability in neurons and cardiomyocytes.

**ECE 762 Digital Control Systems (3 Credit Hours)**
Mathematical representation, analysis, and design of discrete-time and sampled-data control systems. Topics include transfer function and state space representations, stability, the root locus method, frequency response methods, and state feedback.

**ECE 763 Multivariable Control Systems (3 Credit Hours)**
A comprehensive introduction to techniques applicable in control of complex systems with multiple inputs and outputs. Both the frequency domain and state variable approaches are utilized. Special topics include robust and optimal control.

**ECE 766 Nonlinear Control Systems (3 Credit Hours)**
An introduction to mathematical representation, analysis, and design of nonlinear control systems. Topics include phase-plane analysis, Lyapunov stability theory for autonomous and nonautonomous systems, formal power series methods and differential geometric design techniques.

**ECE 772 Fundamentals of Solar Cells (3 Credit Hours)**
The course provides an overview of the fundamentals of solar cell technologies, design, and operation. The course is designed for graduate students in Engineering and Science interested in the field of alternative energy. The course objectives are to make sure each student: understands

the various forms of alternative energies, understands solar cell design, understands solar cell operation, and acquires knowledge of the various solar cells technologies. The topics to be covered include: Alternative energies; Worldwide status of Photovoltaics; Solar irradiance; Review of semiconductor properties; Generation, recombination; Basic equations of device physics; p-n junction diodes; Ideal solar cells; Efficiency limits; Efficiency losses and measurements; Module fabrication; c-Si technology; classical; Photovoltaic systems; Design of stand-alone system; Residential PV systems.

**ECE 773 Introduction to Nanotechnologies (3 Credit Hours)**
This course will introduce the rapidly emerging field of nanotechnology with special focus on underlying principles and applications relevant to the nanoscale dimensions. Specifically, this course will cover (1) the basic principles related to synthesis and fabrication of nanomaterials and nanostructures, (2) zero-, one-, two- and three-dimensional nanostructures, (3) characterization and properties of nanomaterials, and (4) application of nanoscale devices.

**ECE 774 Semiconductor Characterization (3 Credit Hours)**
Introduction of basic methods for semiconductor material and device characterization. Topics include resistivity, carrier doping concentration, contact resistance, Schottky barrier height, series resistance, channel length, threshold voltage, mobility, oxide and interface trapped charge, deep level impurities, carrier lifetime, and optical, chemical and physical characterization.

**ECE 775 Non-thermal Plasma Engineering (3 Credit Hours)**
This course covers the fundamental principals governing low temperature plasma discharges and their applications. First the fundamental properties of plasmas are introduced. These include the kinetic theory of gases, collisional processes, and plasma sheaths. Then in-depth coverage of the physical mechanisms underlying the operation of non-equilibrium plasma discharges is presented, including important characteristics such as their ignition, evolution, and eventual quenching. Finally, practical applications of non-thermal plasmas, including applications in biology and medicine, are presented.

**ECE 777 Semiconductor Process Technology (3 Credit Hours)**
Theory, design and fabrication of modern integrated circuits that consist of nano scale devices and materials. Topics include crystal growth and wafer preparation process including epitaxy, thin film deposition, oxidation, diffusion, ion implantation, lithography, dry etching, VLSI process integration, diagnostic assembly and packaging, yield and reliability.

**ECE 780 Machine Learning II (3 Credit Hours)**
Advanced topics in machine learning and pattern recognition systems. Data reduction techniques including principle component analysis, independent component analysis and manifold learning. Introduction to sparse coding and deep learning for data representation and feature extraction.

**ECE 782 Digital Signal Processing II (3 Credit Hours)**
Review of time domain and frequency domain analysis of discrete time signals and systems. Fast Fourier Transforms, recursive and non-recursive digital filter analysis and design, multirate signal processing, optimal linear filters, and power spectral estimation.

**ECE 783  Digital Image Processing  (3 Credit Hours)**
Principles and techniques of two-dimensional processing of images. Concepts of scale and spatial frequency. Image filtering in spatial and transform domains. Applications include image enhancement and restoration, image compressing, and image segmentation for computer vision.

**ECE 784  Computer Vision  (3 Credit Hours)**
Principles and applications of computer vision, advanced image processing techniques as applied to computer vision problems, shape analysis and object recognition.

**ECE 787  Digital Communications  (3 Credit Hours)**
Fundamental concepts of digital communication and information transmission: information sources and source coding; orthonormal expansions of signals, basis functions, and signal space concepts; digital modulation techniques including PAM, QAM, PSK and FSK; matched filters, demodulation and optimal detection of symbols and sequences; bandwidth; mathematical modeling of communication channels; channel capacity.

**ECE 795  Topics in Electrical and Computer Engineering  (3 Credit Hours)**
Topics in Electrical and Computer Engineering

**ECE 797  Independent Study  (1-3 Credit Hours)**
This course allows students to develop specialized expertise by independent study (supervised by a faculty member).

**Capstone Course for the Project Option**

**ECE 698  Master's Project  (1-3 Credit Hours)**
Individual project directed by the student's professor in major area of study.

**Course for the Thesis Option**

**ECE 699  Thesis  (1-6 Credit Hours)**
Directed research for the master's thesis.

## APPENDIX C
## FACULTY CURRICULUM VITAE (ABBREVIATED)

**Al-Assadi**, **Waleed K.,** Ph.D., 1996, Computer Engineering, Colorado State University. Lecturer of Electrical and Computer Engineering. Specialization areas: IC design, signal integrity, hardware cybersecurity, and reliability of nanotechnology-based systems.
**Alsharif, Salim,** Ph.D., 2002, Electrical Engineering, Florida Institute of Technology. Lecturer of Electrical & Computer Engineering. Specialization areas: computer network, communication systems, microprocessor interfacing, embedded systems, and signal processing.
**Audette, Michel,** Ph.D., 2002, Biomedical Engineering, McGill University. Associate Professor of Electrical and Computer Engineering. **Specialization areas: medical/surgical simulation, surgical planning, and medical device facilitation.**
**Baumgart, Helmut**, Ph.D., 1981, Physics, University of Stuttgart and Max Planck Institute of Solid State Research (Germany). Professor of Electrical and Computer Engineering and Virginia Micro-Electronics Consortium Endowed Professorship in Microelectronics. Specialization areas: thin films, synthesis of nested nanotube composites, microfluidic devices and electroosmotic pumps, silicon-on-insulator (SOI), and high-performance devices.
**Belfore II**, **Lee A.,** Ph.D., 1990, Electrical Engineering, University of Virginia; PE. Associate Professor of Electrical and Computer Engineering. **Specialization areas: virtual reality, artificial neural networks, fuzzy logic, computer assisted medical diagnosis, and fault-tolerant computing.**
**Chen, Chung-Hao,** Ph.D., 2009, University of Tennessee Associate Professor of Electrical and Computer Engineering. Specialization areas: Computer Vision, Robotics, Image Processing, Intelligent Systems, Data Mining, Networked Sensors, Biometrics, Network and Transportation Traffic Analysis, Image and Video Forensic.
**Dhali, Shirshak K.,** Ph.D., 1984, Electrical Engineering, Texas Tech University; PE. Professor of Electrical and Computer Engineering. Specialization areas: atmospheric Pressure Plasma Processing, Wind Energy and Analog VLSI.
**Elsayed-Ali, Hani E.,** Ph.D., 1985, Electrical Engineering, University of Illinois-Urbana. Designated as an Eminent Scholar. Batten Endowed Professor of Electrical and Computer Engineering and Director of the Applied Research Center. Specialization areas: materials, lasers, semiconductors, surface analysis, thin film technology, and physical electronics.
**Gonzalez**, **Oscar R.,** Ph.D., 1978, Electrical Engineering, University of Notre Dame. Professor and Chair of Electrical and Computer Engineering. Specialization areas: control systems, autonomous, fault tolerant and cyber-security systems.
**Gray, William Steven,** Ph.D., 1989, Electrical Engineering, Georgia Institute of Technology. Associate Professor of Electrical and Computer Engineering. Specialization areas: formal power series methods for nonlinear systems analysis; realization theory and model reduction for nonlinear systems; fault-tolerant control for safety critical systems.
**Iftekharuddin, Khan M.,** Ph.D., 1995, Electrical Engineering, University of Dayton. Professor of Electrical and Computer Engineering and Batten Endowed Chair in Engineering.

Specialization areas: signal and image processing, neural networks applications, time-frequency analysis, sensors and embedded system design, and cybersecurity.
**Jiang, Chunqi,** Ph.D., 2002, Electrical Engineering, Old Dominion University. Professor of Electrical and Computer Engineering. Specialization areas: atomospheric pressure nanosecond pulsed plasma jets, compact pulsed power systems, and non-equilibrium plasmas for environmental and biomedical applications.
**Kong, Michael Ganyu**, Ph.D., 1992, Electrical Engineering, University of Liverpool (UK). Professor of Electrical and Computer Engineering and Batten Endowed Chair in Bioeletrics. Specialization areas: cold atmospheric plasma, and its biological effects and applications in medicine, agriculture, and environmental remediation.
**Lakdawala, Vishnukumar K.**, Ph.D., 1980, Electrical Engineering, University of Liverpool (U.K.). Associate Professor of Electrical and Computer Engineering. **Specialization areas:** electron attachment in fluorine compounds, breakdown studies in compressed gases and vacuum, material characterization and simulation studies in compound semiconductors, and high-power semiconductor switches.
**Laroussi**, **Mounir,** Ph.D., 1988, Electrical Engineering, University of Tennessee, Knoxville. Professor of Electrical and Computer Engineering. Specialization areas: plasma science, biomedical applications of plasmas, gaseous electronics, EM waves interactions with plasmas, and plasma processing.
**Leathrum, James F.,** Ph.D., 1992, Electrical Engineering, Duke University. Associate Professor of Electrical and Computer Engineering. Specialization areas: investigation of ways to accelerate force computations underlying molecular dynamics and astrophysical simulations on parallel computers.
**Li, Jiang,** Ph.D., 2004, Electrical Engineering, University of Texas at Arlington. Professor of Electrical and Computer Engineering. Specialization areas: machine learning, computer-aided medical diagnosis systems, medical signal/image processing, neural network and modeling and simulation.
**Marsillac, Sylvain,** Ph.D., 1996, Nanoscale Materials Science, University of Nantes (France). Designated as an Eminent Scholar. Professor of Electrical and Computer Engineering. Specialization areas: microelectronics, solar cells, inorganic materials synthesis and deposition, materials and devices, characterization, and thin films and devices fabrication.
**Namkoong, Gon,** Ph.D., 2003, Electrical and Computer Engineering, Georgia Institute of Technology. Professor of Electrical and Computer Engineering. Specialization areas: development of nitride/ZnO-based thin films, nanorods and their devices on innovative substrate materials as well as applying new nanoscale thin film growth techniques to facilitate material and device improvement.
**Nawarathna, Dharmakeerthi,** Ph.D., 2005, Applied Physics, University of Houston. Associate Professor of Electrical and Computer Engineering. Specialization areas: electromagnetism, circuit design and micro/nano fabrication for developing next generation tools for biology, clinical diagnostics and screening.
**Popescu, Dimitrie C.,** Ph.D., 2002, Electrical and Computer Engineering, Rutgers University. Professor of Electrical and Computer Engineering. Specialization areas: embedded systems and wireless networking.
**Shen, Yuzhong, Ph.D., 2004, Electrical Engineering, University of Delaware. Professor of Electrical and Computer Engineering. Specialization areas: signal and image processing, visualization and computer graphics, and modeling and simulation.**

**Shetty, Sachin, Ph.D., 2007, Modeling and Simulation, Old Dominion University. Professor of Electrical and Computer Engineering.** Specialization areas: cybersecurity.
**Slaughter, Gymama,** PhD., 2005, Computer Engineering, Virginia Commonwealth University. Executive Director of the Center for Bioelectronics and Associate Professor of Electrical and Computer Engineering. Specialization areas: biosensors and bioelectronics, BioMems, cell-instructive adhesive materials for regenerative medicine, wound healing, and biomaterials for modulating inflammation and infection.
**Sosonkina**, **Masha,** Ph.D., 1997, Computer Science and Applications, Virginia Polytechnic Institute and State University. Professor of Electrical and Computer Engineering. Specialization areas: massively parallel optimization, electronic structure theory, next generation hpc architectures, and exoscale computing.
**Vahala, Linda L.,** Ph.D., 1983, Applied Physics, Old Dominion University. Associate Professor of Electrical and Computer Engineering. Specialization areas: plasma physics and atomic physics with an emphasis on laser interactions with plasma and with neutral/rare gas collisions.
**Xiao, Shu,** Ph.D., 2004, Electrical Engineering, Old Dominion University. Professor of Electrical and Computer Engineering. Specialization areas: pulsed power, bioelectrics, high power antennas.
**Xin, Chunsheng,** Ph.D., 2002, Computer Science and Engineering, State University of New York at Buffalo. Professor of Electrical and Computer Engineering. Specialization areas: cybersecurity, cognitive radio networks, wireless communications and networking, cyber-physical systems, and performance evaluation and modeling.
**Yang, Hong,** Ph.D., 2012, Civil Engineering, Rutgers University. Associate Professor of Electrical and Computer Engineering. **Specialization areas:** multi-sensor system for data-driven performance, and modeling and simulation.

## APPENDIX D – EXTERNALLY FUNDED GRANTS

## APPENDIX E - EMPLOYMENT DEMAND – LETTER OF SUPPORT

## APPENDIX F -EMPLOYMENT DEMAND - EMPLOYER SURVEY

# Employer Survey for MS degree

Start of Block: Default Question Block

**Old Dominion University (ODU) is proposing a Master of Science in Electrical and Computer Engineering to begin in Fall 2025. We are contacting you to determine the level of interest in this graduate program among potential employers. Your participation is voluntary and your responses are anonymous.**

**The M.S. in Electrical and Computer Engineering is a 31 credit-hour degree. It is designed to help prepare technology leaders who will fill the demand for highly skilled electrical and computer engineering specialists and practitioners. It will prepare its graduates for high-level positions, working in a wide variety of capacities to analyze and solve practical electrical and computer engineering problems. Students will be educated to develop skills and competencies in technical aspects of electrical and computer engineering fields, including systems, signal and image processing, physical electronics, computer engineering, and cybersecurity engineering.**

**This proposed program offers three options:**

- **The M.S. degree thesis option requires a minimum of 25 credit hours of courses (including the 1 credit hour Graduate Seminar) and 6 credit hours of thesis along with the oral thesis defense examination.**
- **The M.S. degree project option requires a minimum of 28 credit hours of courses (including the 1 credit Graduate Seminar) and 3 credit hours of Master's project course that includes an oral defense examination.**
- **The M.S. degree course option requires a minimum of 31 credit hours of courses (including the 1 credit Graduate Seminar) and a written comprehensive examination at the end of the course work.**

**Graduate courses consist of five core courses (16 credit hours), including instrumentation, automatic control systems, linear systems, numerical methods in engineering analysis, digital signal processing, and graduate seminar, and selective courses includes advanced topics related to physical electronics, cybersecurity engineering, networking, biomedical engineering, data analytics, power, semiconductor, and computer vision.**

Page Break

**How interested would your organization be in hiring an applicant with the M.S. in Electrical and Computer Engineering described on the previous page?**

- Very interested
- Somewhat interested
- Not sure
- Not very interested
- Not at all interested

**What is the likelihood that you would hire an applicant with M.S. in Electrical and Computer Engineering from ODU if that applicant met all other hiring requirements?**

- Very likely
- Somewhat likely
- Not sure
- Somewhat unlikely
- Not at all likely

**Does your organization need skills that are difficult to find in the typical applicant pool?**

◯ Yes

◯ No

*Display This Question:*

*If Does your organization need skills that are difficult to find in the typical applicant pool? = Yes*

**Does the M.S. in Electrical and Computer Engineering address some of those needed skills?**

◯ Yes

◯ No

**Please provide feedback on how this M.S. in Electrical and Computer Engineering program would fit with your current and/or future hiring needs.**

________________________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

**What type of organization/industry do you work in? (check all that apply)**

- ▢ Education
- ▢ Energy
- ▢ Federal, State, or Local Government
- ▢ Technology
- ▢ Healthcare
- ▢ IT
- ▢ Military
- ▢ Other ________________________________________________

**In what city/state is your organization located?**

________________________________________________________________

**Thank you for completing this survey. Please click "next" to submit your answers.**

End of Block: Default Question Block

**APPENDIX G- EMPLOYMENT DEMAND - JOB ANNOUNCEMENTS**

**APPENDIX H - STUDENT DEMAND - STUDENT SURVEYS**

# Student Survey

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Start of Block: Default Question Block

**Old Dominion University (ODU) is proposing a PhD in Electrical and Computer Engineering degree, instead of General Engineering degree with the concentration on Electrical and Computer Engineering. We are contacting you to determine the level of interest in this program among potential students. Your participation is voluntary, and your responses are anonymous.**

**The proposed PhD in Electrical and Computer Engineering degree would be a 79-credit hours program beyond the bachelor's degree (49-credit hours post master's). The program is designed to prepare future leaders in electrical and computer engineering research. Graduates will develop skills and competencies in technical aspects of electrical and computer in a diversity of current and emerging electrical and computer technologies and will be prepared to assume responsibility for the management of electrical and computer projects and coordination of electrical and computer research and development teams. Graduates will fill the demand for senior lead positions such as Research Analyst, Program Manager, Scientist, Faculty, and R&D Manager within academic, federal government, state government, non-profit, and private sector environments. The program will also prepare graduates to teach electrical and computer courses in 2- and 4-year colleges and universities.**

**What is your level of interest in the Electrical and Computer Engineering PhD program described above?**

- Very interested
- Somewhat interested
- Not very interested
- Not at all interested

**What is the likelihood that you would enroll in the Electrical and Computer Engineering PhD program at Old Dominion University described above?**

- Very likely
- Somewhat Likely
- Not very likely
- Not at all likely

*Display This Question:*

*If What is your level of interest in the Electrical and Computer Engineering PhD program described above? = Not very interested*

*Or What is your level of interest in the Electrical and Computer Engineering PhD program described above? = Not at all interested*

*And If*

*What is the likelihood that you would enroll in Electrical and Computer Engineering PhD program at Old Dominion University describe... = Not very likely*

*Or What is the likelihood that you would enroll in Electrical and Computer Engineering PhD program at Old Dominion University describe... = Not at all likely*

**Thank you for your time. Please click "Next" to submit your survey responses.**

*Skip To: End of Survey If Thank you for your time. Please click "Next" to submit your survey responses.() Is Displayed*

**If you enrolled in the Electrical and Computer Engineering PhD program, would you expect to earn:**

- ◯ General Engineering Degree with the concentration on Electrical and Computer Engineering
- ◯ Electrical and Computer Engineering Degree

**If you enrolled in the Electrical and Computer Engineering PhD program would you expect to be:**

- ◯ A full-time student
- ◯ A part-time student

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What is your class rank?

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Other, please specify: ________________________________

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**Which of the following would influence your decision to pursue an Electrical and Computer Engineering PhD program at ODU?**
**Select all that apply.**

- [ ] Opportunity to achieve professional goals
- [ ] Opportunity to work in Electrical & Computer Engineering industry
- [ ] Opportunity to work in Electrical & Computer Engineering industry with the Hampton Roads area
- [ ] Proximity of the campus to where I work/live
- [ ] Reputation of faculty
- [ ] Availability of night courses
- [ ] Availability of streamed courses
- [ ] Opportunity to expand working knowledge of Electrical and Computer Engineering
- [ ] Other: ______________________________

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**Could you please comment on how this PhD program in Electrical and Computer Engineering would fit with current or future career goals?**

________________________________________

________________________________________

________________________________________