

# Frank Batten College of Engineering and Technology

**Web Site:** <http://www.odu.edu/eng> (<http://www.odu.edu/eng/>)

Jeffrey Fergus, Dean

Jeffrey LaCombe, Associate Dean for Undergraduate & Graduate Education

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Stacie Ringleb, Associate Dean for Faculty Affairs and Student Engagement

Anthony Dean, Assistant Dean for Maritime and Defense Initiatives

## Mission Statement

In accordance with the mission of Old Dominion University, the Frank Batten College of Engineering and Technology promotes the advancement of engineering knowledge, both by its creation and dissemination and by providing successful graduates and a continuously improving learning environment to its constituents, while maintaining ethical, multicultural and global standards.

## College Diversity, Equity, and Inclusion Statement

The Frank Batten College of Engineering and Technology recognizes that diversity and inclusion are foundational to developing creative and robust engineering solutions to address complex global challenges. We are committed both to a diverse, equitable, and inclusive environment for students, faculty, and staff and to educating our students on the need for these in the engineering profession.

## Overview

The Frank Batten College of Engineering and Technology at Old Dominion University offers degrees in engineering and in engineering technology. The course of study that leads to engineering degrees is characterized by a solid foundation in the theoretical underpinnings of engineering based on science and mathematics. Graduates of our undergraduate programs are well equipped to pursue advanced study through graduate education, pursue professional registration, or enter the engineering profession. The course of study that leads to engineering technology degrees is characterized by strong laboratory experiences and an emphasis on the application of engineering fundamentals and techniques that will prepare the graduate to be ready to embark on applied engineering career paths and implement advanced design, analysis and development concepts. The engineering technology degree is considered to be a terminal degree and graduates are prepared for manufacturing, testing, production, and operations.

The engineering and engineering technology programs at Old Dominion University are specifically designed to take advantage of the unique assets in the Hampton Roads area. These assets include:

1. a strong technology center to promote and use modeling and simulation
2. the NASA Langley Research Center with its focus on aerospace and virtual environments
3. the Jefferson Laboratories, a major center of nuclear physics and engineering
4. one of the major international deep-water ports on the east coast of the United States
5. a major shipbuilding and ship repair industry
6. a major high technology industry base
7. a very large presence of military facilities and military contractors

These assets have enabled the development of distinctive engineering and technology curricula. Points of distinction (from other programs in and out of the state) include the following:

## Engineering Up-Front

Freshmen immediately become engaged in practical engineering and technology activities through a required course, ENGN 121 Introduction to Engineering and Technology. Team projects in different engineering disciplines allow students to experience the professional spectrum from idea generation through its translation into the design, manufacture, and commercialization cycle. This course is well-suited to aid students in selecting a specific engineering discipline for their major for the remainder of their studies.

## Multi-Disciplinary Industry Senior Project

Seniors may choose to join a multi-disciplinary team of students led by faculty and industry representatives to work on an industry project subject to specific deliverables and time and budget constraints.

## Linked Bachelor's/Graduate Degree Programs

Undergraduate students in the Batten College of Engineering and Technology may apply for early admission into an engineering graduate program and may be permitted to apply credits for some courses simultaneously to both degrees. The degrees need not be in the same field of engineering.

## Monarch Engineering and Innovation Laboratory (M-Lab)

Undergraduate and graduate students in the Batten College of Engineering and Technology have access to the M-Lab (<https://www.odu.edu/mlab/>) a 6,500 square-foot facility where they can learn how to use advanced hardware and software tools that enable 1) the analysis of complex problems, 2) the development of engineering solutions, 3) the analysis and testing of engineering solutions, 4) the development of prototypes from low to high-fidelity, 5) collaboration with students from different engineering programs and engineering disciplines, 6) collaboration with other colleges within the university, 7) collaboration with industry and research partners, and 8) the promotion of entrepreneurial and commercialization activities.

## Professional Engineer (P.E.) Certification

The College encourages all of its graduates to eventually be certified as Professional Engineers (P.E.). The certification requires taking the Fundamentals of Engineering (FE) Examination and the Professional Engineering (P.E.) Examination. All students are encouraged to take the FE Examination in their senior year. For details, contact the departmental or Dean's Office and the following web site: [www.dpor.virginia.gov](http://www.dpor.virginia.gov) (<http://www.dpor.virginia.gov/>).

For further information, please visit the college's web site: <http://www.odu.edu/eng>. (<http://www.odu.edu/eng/>)

## Programs of Study

### Bachelor of Science (Majors)

#### Engineering Programs

- Civil Engineering - B.S.C.E.
- Computer Engineering (Computer Engineering Major) - B.S.C.E.
- Computer Engineering (Modeling & Simulation Engineering Major) - B.S.C.E.
- Electrical Engineering - B.S.E.E.
- Mechanical Engineering - B.S.M.E.

#### Engineering Technology Program's Majors

- Civil Engineering Technology - B.S.E.T. (Major: Civil Engineering Technology)
- Electrical Engineering Technology - B.S.E.T. (Major: Electrical Engineering Technology)
- Manufacturing Engineering Technology - B.S.E.T. (Major: Manufacturing Engineering Technology)

- Mechanical Engineering Technology - B.S.E.T. (Major: Mechanical Engineering Technology)

## Minors

- Minor in Aerospace Engineering (Department of Mechanical and Aerospace Engineering)
- Minor in Biomedical Engineering (Interdisciplinary, Department of Electrical and Computer Engineering)
- Minor in Civil Engineering (Department of Civil and Environmental Engineering)
- Minor in Civil Engineering Technology-Construction (Department of Engineering Technology)
- Minor in Computer Engineering (Department of Electrical and Computer Engineering)
- Minor in Cybersecurity (Interdisciplinary, see details below)
- Minor in Electrical Engineering (Department of Electrical and Computer Engineering)
- Minor in Electrical Engineering Technology (Department of Engineering Technology)
- Minor in Energy Engineering (Interdisciplinary, see details below)
- Minor in Engineering Management (Department of Engineering Management & Systems Engineering)
- Minor in Engineering Solutions for Climate Adaptation and Resilience
- Minor in Environmental Engineering (Department of Civil and Environmental Engineering)
- Minor in Global Engineering (Interdisciplinary, see details below)
- Minor in Marine Engineering (Department of Engineering Technology)
- Minor in Mechanical Engineering (Department of Mechanical and Aerospace Engineering)
- Minor in Mechanical Engineering Technology (Department of Engineering Technology)
- Minor in Military Leadership (Department of Naval Science)
- Minor in Modeling and Simulation (Department of Electrical and Computer Engineering)
- Minor in Uncrewed Systems Design & Development

## Master's Programs

### Engineering Programs

- Aerospace (Engineering, M.S., M.E.)
- Biomedical (Engineering, M.S., M.E.)
- Civil (Engineering, M.S.)
- Electrical and Computer Engineering (Engineering, M.S.)
- Engineering Management (M.S., M.E.M.)
- Environmental (Engineering, M.S.)
- Mechanical (Engineering, M.S., M.E.)
- Modeling & Simulation Engineering (Engineering, M.S.)
- Systems Engineering (Engineering, M.E.)

## Doctoral Programs

### Engineering Programs

- Aerospace (Engineering, Ph.D.)
- Biomedical (Engineering, Ph.D.)
- Civil and Environmental (Engineering, Ph.D.)
- Cybersecurity Engineering (Engineering, D.Eng.)
- Electrical and Computer (Engineering, Ph.D., D.Eng.)
- Engineering Management and Systems Engineering (Engineering, Ph.D., D.Eng.)
- Mechanical (Engineering, Ph.D., D.Eng.)
- Modeling and Simulation (Engineering, Ph.D., D.Eng.)

## Accreditation

The following are engineering programs accredited by the Engineering Accreditation Commission of ABET [www.abet.org](http://www.abet.org) (<http://www.abet.org>):

- Bachelor of Science in Civil Engineering
- Bachelor of Science in Computer Engineering
- Bachelor of Science in Electrical Engineering
- Bachelor of Science in Mechanical Engineering

The following are engineering technology programs accredited by the Engineering Technology Accreditation Commission ABET [www.abet.org](http://www.abet.org) (<http://www.abet.org>):

- Bachelor of Science in Engineering Technology - Civil Engineering Technology
- Bachelor of Science in Engineering Technology - Electrical Engineering Technology
- Bachelor of Science in Engineering Technology - Mechanical Engineering Technology

The following program is certified by the American Society for Engineering Management [www.asem.org](http://www.asem.org) (<http://www.asem.org>):

- Master of Engineering Management

## Collaborative Programs

### Cardinal Education

Stacie Ringleb, Associate Dean for Faculty Affairs and Student Engagement, ODU Cardinal Education Site Director

The Cardinal Education Program offers ODU engineering graduate students a selection of online graduate courses and programs to complement the on-campus course offerings. It is a unique cooperative agreement that enables engineering students at ODU to enroll (and receive credit for) select online courses from six respected Virginia universities. The Cardinal Program (formerly CGEP) has a 35+ year record of leadership in distance learning.

Partnering engineering schools in the Commonwealth of Virginia include: Old Dominion University, Polytechnic Institute and State University, The University of Virginia, George Mason University, Virginia State University, and Virginia Commonwealth University. The program also serves the diverse continuing education needs of students working in industry and government.

Students seeking course registration via the Cardinal Education Program should contact the Cardinal Education Program Office in the Batten College of Engineering and Technology at Old Dominion University: <https://www.odu.edu/engineering/programs/cardinal-education> (<https://www.odu.edu/engineering/programs/cardinal-education/>)

## Special Programs

### Cooperative Education/Internships Program

The cooperative education programs in the Frank Batten College of Engineering and Technology at Old Dominion University are of the highest academic quality. These programs allow students to combine academic study with professional-level training. Cooperative education positions may be based on the alternating program style in which periods of full-time study are alternated with periods of full-time employment. Participation in the cooperative education program can be a source of financial support to help meet a substantial portion of college expenses. All departments in the Frank Batten College of Engineering and Technology strongly endorse the concept of cooperative education and internships.

### Old Dominion University/Eastern Virginia Medical School Joint Program in Medicine

The joint program in medicine is designed to encourage highly qualified students to receive a BS from Old Dominion University and an MD from Eastern Virginia Medical School. Students apply after completion of their freshman year at Old Dominion University. Upon successful completion

of requirements and graduation from Old Dominion University, a student accepted in the ODU/EVMS Joint Program in Medicine will be guaranteed admission to Eastern Virginia Medical School. Engineering and engineering technology students are encouraged to apply for this program. Complete information can be found in the College of Sciences section of this catalog.

## Engineering Fundamentals Division & Curriculum

The Engineering Fundamentals Division (EFD) is designed to provide support to first-year engineering and transfer students as they make the transition into the Frank Batten College of Engineering and Technology. All students are admitted to this division until they are prepared to successfully take courses in their major. While in this division, students receive individualized counseling, mentoring, and advising support designed to prepare them for success in their chosen engineering or technology major. A key experience for students in this division is ENGN 121 Introduction to Engineering and Technology. This group-oriented course uses hands-on projects to expose students to the spectrum of engineering practices from innovation through design, manufacture and commercialization of a product or process. It also provides students with an opportunity to experience various aspects of engineering and have a basis for selecting their major.

### Admission

Students who qualify for regular admission to the University will be accepted into EFD. Students in EFD may identify a desired degree program or may declare that they are undecided among engineering and engineering technology programs. They will be assigned an intended major code classification, which indicates that they are enrolled and, if appropriate, which is their preferred program.

### Matriculation into an Engineering or Engineering Technology Degree Program

Students must meet with a major advisor and meet the following requirements in order to be declared:

1. Earn an overall GPA of 2.0 or better
2. Earn at least 30 credit hours applicable toward a degree, including the Engineering Fundamental courses listed below
3. Complete ENGN 121
4. Complete ENGN 122. A grade of C or higher may be required for progression in some programs.
5. Complete all freshman-level math courses with a C or higher (MATH 211 & MATH 212 for engineering majors and MATH 162M and MATH 163 or higher for engineering technology majors)
6. Complete any other major-specific requirements

Normally, students are not eligible to enroll in major courses until they are accepted into the degree program. Students may petition to waive this rule when extenuating circumstances warrant.

### Continuance

Students are eligible to continue in the EFD as long as, within two years, they:

1. meet the continuance regulations of the University and
2. make reasonable progress toward matriculation into an engineering or engineering technology program.

A student who has ceased reasonable progress toward matriculation into a college degree program will be notified in writing. One semester following this notification, if reasonable progress has not resumed, the student will be referred to the Center for Major Exploration. A student who successfully completes the requirements must apply to and be accepted by a college degree program. Students not accepted into a degree program during a period of one semester beyond completion of the requirements will be referred to the Center for Major Exploration.

## Computer Requirement

The Frank Batten College of Engineering and Technology requires that all incoming freshmen and transfer students to the college have a notebook or laptop computer that meets or exceeds the Mobile Monarch Student Notebook Program's recommended models for engineering majors. Students are strongly encouraged to consider purchasing one of the Mobile Monarch Student Notebook Program's notebooks; however, students may bring their own notebook if it meets the specifications. Contact the campus Monarch Techstore for technology requirements and student programs at: <https://www.odu.edu/techstore>. (<https://www.odu.edu/techstore/>) Please note, Apple computers are not compatible with many necessary engineering software packages.

## Engineering Fundamentals—Engineering Programs

The following courses are commonly taken during the Freshman year (minor differences will be seen from program to program). Please see the individual department/program pages for four-year academic plans.

### First-Year Engineering Courses

ENGN 121	Introduction to Engineering and Technology *	4
ENGN 122	Computer Programming for Engineering	4
MATH 211	Calculus I	4
MATH 212	Calculus II	4
CHEM 121N	Foundations of Chemistry I Lecture	3
CHEM 122N	Foundations of Chemistry I Laboratory	1
ENGL 110C	English Composition (grade of C or better required)	3
COMM 101R	Public Speaking **	3
PHYS 231N	University Physics I	4
<i>Total Credits</i>		<i>30</i>

\* Meets the lower-division general education information literacy and research requirement.

\*\* Civil Engineering majors may complete Human Creativity during the Freshman year and COMM 101R during the Sophomore year.

## Engineering Fundamentals—Engineering Technology Programs

The Engineering Technology course requirements for the freshman year differ from the above by 1) MATH 211 and MATH 212 are replaced by MATH 162M and MATH 163, 2) COMM 101R is replaced by either ENGL 211C or ENGL 231C, and 3) PHYS 111N is taken in place of PHYS 231N. For additional details, please refer to the degree program guides appearing in the Engineering Technology section.

## Advanced Placement

The University provides for possible advanced placement for up to 60 semester hours of course work. The student should refer to the advanced placement policy of specific departments (Mathematics and Statistics, Physics, Chemistry and Biochemistry, etc.) and the Policy for Prior Learning Assessment Credit Options at the Undergraduate Level found in this Catalog.

Qualified students may take advanced placement examinations in certain courses in the various departments of the Batten College of Engineering and Technology. The student should contact the chair of the department offering the course for information on applicability and approval.

Prospective freshmen are encouraged to take as many advanced placement courses as possible in high school. Further, prospective freshmen are encouraged to take as many AP examinations of the Educational Testing Service and CLEP examinations as possible. Qualifying scores on these examinations may result in advanced placement credit. However, freshmen

should still consult with their faculty advisor before "skipping" courses given at Old Dominion University.

Additional information on advanced placement credit awarded for qualifying scores on AP and IB subject examinations can be found on the equivalency charts on the Office of Undergraduate Admissions website at <https://www.odu.edu/admission/undergraduate/credit> (<https://www.odu.edu/admission/undergraduate/credit>).

## Transfer Students

Transfer students seeking admission to an engineering or engineering technology program at Old Dominion University must complete the standard admission procedures as established by the Office of Admissions.

Transfer students are usually in one of the following categories:

1. students who have completed some course work, but who have not completed associate degrees
2. students who have completed associate degrees in appropriate fields before transferring.

Certain special policies have been developed for students in category (2). If the overall educational background of the transfer student who has completed an associate degree is felt to be sufficiently strong to permit them to pursue upper-division work satisfactorily, a composite or "package" evaluation of transfer credit may be made. This approach will permit some flexibility in accommodating students with slightly different but equally appropriate backgrounds, dependent on the engineering or engineering technology program involved. Certain deficiencies can be made up while the student is pursuing upper-division studies.

To be admitted as a transfer student with departmental junior standing, the student should have either completed an associate degree in an acceptable program or received full credit for two years of work indicated by the completion of the equivalent number of semester hours in the chosen engineering or engineering technology curriculum with a grade of C or better in each course.

Transfer students must earn a minimum of 25 percent of the total number of credits required for the degree from Old Dominion University and complete a minimum of 12 credit hours in upper-level courses in the major program from Old Dominion University.

Students transferring from the Virginia Community College System may view information about Old Dominion University's Guaranteed Admission Agreement, curriculum sheets, the letter of intent process, and Articulation Agreements on the Transfer Student Centers website (<http://www.odu.edu/newtransfer/advising/>).

## Departments

- Civil and Environmental Engineering (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/>)
- Electrical and Computer Engineering (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/>)
- Engineering Management and Systems Engineering (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-management-systems/>)
- Engineering Technology (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/>)
- Mechanical and Aerospace Engineering (<http://catalog.odu.edu/undergraduate/engineering-technology/mechanical-aerospace-engineering/>)
- Naval Science (Naval Reserve Officers Training Corps) (<http://catalog.odu.edu/undergraduate/engineering-technology/naval-science/>)

## Programs

### Bachelor of Science in Civil Engineering

- Civil Engineering (BSCE) (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/civil-engineering-bsce/>)

### Bachelor of Science in Computer Engineering

- Computer Engineering (BSCE) (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/computer-engineering-bsce/>)
- Computer Engineering with a Major in Modeling & Simulation Engineering (BSCE) (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/computer-engineering-modeling-simulation-bsce/>)

### Bachelor of Science in Electrical Engineering

- Electrical Engineering (BSEE) (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/electrical-engineering-bsee/>)

### Bachelor of Science in Engineering Technology

- Engineering Technology with a Major in Civil Engineering Technology (BSET) (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/engineering-technology-civil-bset/>)
- Engineering Technology with a Major in Electrical Engineering Technology (BSET) (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/engineering-technology-electrical-bset/>)
- Engineering Technology with a Major in Manufacturing Engineering Technology (BSET) (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/engineering-technology-manufacturing-bset/>)
- Engineering Technology with a Major in Mechanical Engineering Technology (BSET) (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/engineering-technology-mechanical-bset/>)

### Bachelor of Science in Mechanical Engineering

- Mechanical Engineering (BSME) (<http://catalog.odu.edu/undergraduate/engineering-technology/mechanical-aerospace-engineering/mechanical-engineering-bsme/>)

## Minor Programs

- Aerospace Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/mechanical-aerospace-engineering/aerospace-engineering-minor/>)
- Biomedical Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/biomedical-engineering-minor/>)
- Civil Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/civil-engineering-minor/>)
- Civil Engineering Technology - Construction Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/civil-engineering-technology-construction-minor/>)
- Computer Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/computer-engineering-minor/>)
- Cybersecurity Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/minors/cybersecurity-minor/>)
- Electrical Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/electrical-engineering-minor/>)



- Electrical Engineering Technology Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/electrical-engineering-technology-minor/>)
- Energy Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/minors/energy-engineering-minor/>)
- Engineering Management Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-management-systems/engineering-management-minor/>)
- Engineering Solutions for Climate Adaptation and Resilience Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/engineering-solutions-climate-adaptation-resilience-minor/>)
- Environmental Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/civil-environmental-engineering/environmental-engineering-minor/>)
- Global Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/minors/global-engineering-minor/>)
- Marine Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/marine-engineering-minor/>)
- Mechanical Engineering Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/mechanical-aerospace-engineering/mechanical-engineering-minor/>)
- Mechanical Engineering Technology Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/engineering-technology/mechanical-engineering-technology-minor/>)
- Military Leadership Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/naval-science/military-leadership-minor/>)
- Modeling and Simulation Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/electrical-computer-engineering/modeling-simulation-minor/>)
- Uncrewed Systems Design & Development Minor (<http://catalog.odu.edu/undergraduate/engineering-technology/minors/uncrewed-systems-design-and-development-minor/>)

## Naval ROTC Program

- NROTC (<http://catalog.odu.edu/undergraduate/engineering-technology/naval-science/nrotc/>)

## Linked Bachelor's/Master's Degree Programs

Linked Bachelor's/Master's programs are designed to allow qualified students to secure a space in a master's program available in the Frank Batten College of Engineering and Technology while they are still pursuing their undergraduate degrees. An eligible student can choose a master's program in the same discipline as his/her bachelor's program or in a complementary discipline. Subject to the approval of the undergraduate and graduate program directors, a student enrolled in a linked program can count up to six credit hours of course work towards both the undergraduate and the graduate degrees. Full-time students may be able to complete the requirements for the bachelor's degree in four years and the master's degree in one additional year. Students in linked programs must earn a minimum of 150 credit hours (120 discrete credit hours for the undergraduate degree and 30 discrete credit hours for the graduate degree).

Students who are matriculated in an undergraduate major in the Frank Batten College of Engineering and Technology with a GPA of at least 3.00 overall and 3.00 in the major are eligible to apply for admission to a Linked Bachelor's/Master's program. Transfer students who desire to be admitted to a linked program at the time they join an undergraduate major at Old Dominion University are eligible to apply if their overall GPA at their previous institution is 3.25 or higher. Prerequisite courses may be required for engineering technology majors to pursue a master's degree in engineering.

Continuance in a Linked Bachelor's/Master's program requires maintenance of a GPA of 3.00 or higher overall and in the major.

## Linked Bachelor-to-PhD Programs

For a select number of exceptionally well-qualified students, the college has established a linked doctoral program that enables students to be admitted directly into the PhD program upon completion of the baccalaureate degree. A select number of exceptionally well-qualified students can be admitted to the Bachelor/PhD program in their junior year while they are pursuing one of the undergraduate programs at Old Dominion University. This program encourages admitted students to work closely with faculty members and pursue a research experience. Just as in the Linked Bachelor/Masters program, six credit hours of graduate course work may again be counted towards the undergraduate degree and doctoral course work mentioned above for the Bachelor/PhD program. For linked bachelor's to doctoral programs, students must earn a minimum of 198 credit hours (120 discrete credit hours for the undergraduate degree and 78 discrete credit hours for the graduate degree). Students in these programs must maintain a GPA of 3.50 or better throughout their bachelor's and doctoral studies.

The student may opt to obtain the master's degree along the way to the doctorate. To obtain the master's degree, the student must utilize the six graduate credits obtained as part of their undergraduate program, use 18 credits of the graduate course work that is part of the PhD, and work with the Graduate Program Director to plan the final 6 credits.

## Enterprise Centers

The Batten College of Engineering and Technology is a catalyst for the economic development of Hampton Roads. To this end, the college has established a number of centers to serve as engines for enterprise development. These centers utilize all University resources, including students and faculty.

### Applied Research Center (ARC)

Hani Elsayed-Ali, Director

ARC is an advanced materials engineering and laser technology research center. Staffed with industry/university teams utilizing the Jefferson Lab technologies, ARC provides commercial product-related research in the areas of thin-film technology, laser and plasma processing of materials, materials analysis, and devices and sensor fabrication. For more information: [www.odu.edu/engineering/applied-research-center](http://www.odu.edu/engineering/applied-research-center) (<https://www.odu.edu/engineering/applied-research-center/>).

### Frank Reidy Research Center for Bioelectronics

Andrei Pakhomov, Executive Director

The mission of the Center is to increase scientific knowledge and understanding of the interaction of electromagnetic fields and ionized gases with biological cells and to apply this knowledge to the development of medical diagnostics, therapeutics, and environmental contamination. The objectives of the Center are to perform leading-edge interdisciplinary and multi-institutional research, recruit top faculty and exceptional graduate students, support regional, national, and international programs, and increase external funding and institutional visibility. For more information: [www.odu.edu/bioelectronics](http://www.odu.edu/bioelectronics) (<https://www.odu.edu/frank-reidy-research-center-bioelectronics/>).

## Affiliated Centers

### Center for Secure and Intelligent Critical Systems

Sachin Shetty, Director

The Center for Secure and Intelligent Critical Systems (CSICS) conducts research on developing and integrating secure and intelligent technologies to ensure safe, reliable, and resilient infrastructure for the future. CSICS focuses on both theoretical and practical research in computational modeling, simulation, and analysis. For more information: <https://sics-c.org/>

### Institute for Coastal Adaptation and Resilience

Jessica Whitehead, Executive Director

ICAR's mission is to advance the practice of coastal resilience and adaptation by engaging with communities, organizations, and businesses to develop and deploy solutions based on integrated, innovative, and applied research. For more information: <https://oduadaptationandresilience.org/>.

## Commonwealth Center for Recurrent Flooding

Carol Considine, ODU Contact

The Commonwealth Center for Recurrent Flooding Resiliency engages the expertise, resources, and intellectual vibrancy of William & Mary and Old Dominion University in support of building resilience to rising waters. The Center serves, advises, and supports Virginia by conducting interdisciplinary studies and providing training, technical and non-technical services, and policy guidance in the area of recurrent flooding resilience to the Commonwealth and its local governments, state agencies, industries, and citizens.. For more information: <https://www.floodingresiliency.org/>

## Mission Engineering Center

Thomas Irwin, Executive Director

The Center for Mission Engineering (CME) is an interdisciplinary applied research center focused on advancement in designing, analyzing, integrating, and improving the ability of systems to deliver desired mission outcomes. For more information: <https://oduinnovate.org/research-enterprise/center-for-mission-engineering/>

## Virginia Digital Maritime Center

Mark Whitney, Executive Director

The Virginia Digital Maritime Center's mission is to support Virginia's maritime enterprise by leveraging applied research & cutting-edge technology to advance the maritime workforce, foster collaborative partnerships, and drive economic growth in Hampton Roads. For more information: <https://digitalmaritime.org/>

## Virginia Institute for Spaceflight and Autonomy

Yiannis Papelis, Executive Director

The Virginia Institute for Spaceflight and Autonomy cultivates partnerships between governments, industry, and academia to grow the spaceflight and autonomy ecosystems on the Eastern Shore. For more information: <https://visaatodu.org/>

## Virginia Modeling, Analysis, and Simulation Center

Eric Weisel, Associate Vice President for Applied Research and Executive Director, VMASC

The Virginia Modeling, Analysis, and Simulation Center (VMASC) is an enterprise center of Old Dominion University, supporting the University's research mission through innovation, workforce development, and industry ecosystem engagement programs that create and integrate digital technologies into everyday practice. The Center performs applied research leading to digital transformation. For more information: [www.vmasc.org](http://www.vmasc.org) (<http://www.vmasc.org/>).

## Virginia Beach Institute of Data Science

Khan Iftekharuddin, Director

The Virginia Beach Data Science Institute is at the forefront of education, research and collaboration for Hampton Roads region, state and globally. The Institute aims to be a driving force for building a vibrant academic community that will educate new generations of builders, thinkers, and leaders.

## College Institutes

**Institute for Autonomous and Connected Systems:** The mission of IACS is to bring together faculty and students across campus from the Colleges of Engineering & Technology, Arts & Letters, and Sciences who have mutual interest in advancing the interdisciplinary research and development of autonomous and connected systems including un-crewed and autonomous

vehicles in air, land, space, and maritime applications. Interim Director: Thomas Alberts.

## Institute for Engineering in Medicine, Health, and Human

**Performance:** The Institute for Engineering in Medicine, Health, and Human Performance (EnMed) is the trans-disciplinary home for innovative biomedical research, founded on unique academic, industrial, and military footprints at ODU and in Hampton Roads, to improve patient and community health outcomes and advance human performance. Director: Lobat Tayebi.

## Departmental Centers and Institutes

**Sustainable Development Institute** promotes and provides engineering, ecological, environmental, and economic assistance to local, regional, and national governmental agencies, as well as international organizations and businesses. The institute actively participates in community service by conducting waste minimization and pollution prevention assistance to local businesses. Director: Mujde Erten-Unal.

**Transportation Research Institute** collaborates with centers and departments across the ODU campus to conduct innovation-based research in the core areas of transportation operations, transportation safety, transportation planning, freight transportation, and environment, energy, and sustainable transport. Director: Mecit Cetin.

**Virginia Institute for Photovoltaics** research spans from the Nanoscale (Fundamental Sciences and Engineering) through the Devices and balance of systems, to the deployment of Gigascale commercial power generation. The current focus is to research and develop the Science and Engineering of Photovoltaic Devices (or Solar cells) and bring them from the laboratory to the industry. Director: Sylvain Marsillac.

**Virginia Institute for Image and Vision Analysis** aims to leverage complimentary expertise of faculty in computer vision, signal/image processing and machine learning to become one of the leading institutes in the field. Research focuses on novel theory, state-of-art algorithms, architectures, real-time implementations for biomedical engineering, human and machine-centric recognition, environmental and geoscience applications and computer-aided medical diagnosis systems. Director: Khan Iftekharuddin.

**Center for Bioelectronics:** The mission of the Center is to lead the effort of advancing scientific frontiers, ensuring educational accessibility for underrepresented students in STEM, and securing research leadership in critical areas, such as smart health and biomedical research. The ODU Center for Bioelectronics is dedicated to the mission of diversity, equity, and inclusion in education and the workforce. Director: Gymama Slaughter.