Frank Batten College of Engineering and Technology

Web Site: http://www.odu.edu/eng

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Oktay Baysal, Dean
Shirshak K Dhali, Associate Dean
Linda Vahala, Associate Dean

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.

Overview
The Frank Batten College of Engineering and Technology at Old Dominion University offers degrees in engineering and engineering technology.

The graduate engineering programs at Old Dominion University are specifically designed to take advantage of and enhance unique assets in the Hampton Roads area, a complex of seven major cities. These assets include: 1) a strong military presence with multiple high technology facilities, particularly as it relates to modeling and simulation; 2) the NASA Langley Research Center with its focus on aeronautics and space exploration; 3) the Jefferson Laboratories, a major center of nuclear physics and home of a major Free Electron Laser; 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, including Newport News Shipbuilding, the only builder of nuclear aircraft carriers in the U.S.; 6) a major high technology industry base; and 7) a variety of commercial enterprises. These assets have enabled the development of distinctive engineering curricula.

Programs of Study
Table 1 lists the programs of study offered at master’s and/or doctoral levels. Master's degree programs include Master of Engineering (ME), Master of Engineering Management (MEM) and Master of Science (MS). Doctoral degree programs include Doctor of Engineering (DEng) and Doctor of Philosophy (PhD).

Table 1: Graduate Degrees Offered

<table>
<thead>
<tr>
<th>Programs of Study</th>
<th>ME</th>
<th>MEM</th>
<th>MS</th>
<th>DEng</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace Engineering (AE)</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Biomedical Engineering (BME)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Civil Engineering (CE)</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Civil and Environmental Engineering (CEE)</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical and Computer Engineering (ECE)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Management (ENMA)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Management and Systems Engineering (EMSE)</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Engineering (ME)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineering (ME)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modeling &amp; Simulation (MSIM)</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems Engineering (SysE)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Linked Degree Programs
Bachelor’s to Master’s programs
Bachelor’s to Ph.D. programs

Graduate Certificate Programs
- Advanced Engineering Certificate in
- Biomedical Engineering
- Cyber Systems Security
- Energy Systems
- Engineering Management
- Coastal Engineering Certificate
- Entrepreneurship and Innovation in Engineering Certificate
- Homeland Security Certificate
- Modeling and Simulation Engineering Certificate
- Naval Architecture and Marine Engineering
- Project Management Certificate

Collaborative Programs
Commonwealth Graduate Engineering Program (CGEP)

Master’s-Level Programs
The Batten College of Engineering and Technology grants the following Master’s degrees: Master of Science in Engineering, Master of Engineering, and Master of Engineering Management. The programs of study leading to the master’s degree are listed in Table 1. Interested students should refer to the individual program section of this catalog for admission information and degree requirements.

Linked Bachelor's to Master’s Degree Programs
These 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 can complete the requirements for the Bachelor’s degree in four years and for the Master’s degree in one additional year.

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 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. Pre-requisite 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.

Doctor of Philosophy (Ph.D.) Programs
The Batten College of Engineering and Technology grants the Doctor of Philosophy degree in Engineering. The programs of study leading to the Ph.D. degree are listed in Table 1. Interested students should refer to the individual program section of this catalog for admission information and degree requirements.

Linked Bachelor's to Ph.D. Programs
For a select number of exceptionally well-qualified students, the college has established an integrated doctoral program that enables students to be admitted directly into the Ph.D. program upon completion of the baccalaureate degree. The total number of graduate course credits required is 48 plus a 24-credit dissertation. That is six credit hours shorter than...
Admission Criteria
Consideration for admission to the Doctor of Engineering program requires a formal application, undergraduate and graduate transcripts, and two letters of recommendation. Also required is an essay describing the applicant’s preparation for graduate work, personal and academic goals, and professional objectives. One of the letters of recommendation should be from an agency point of contact if a sponsoring agency is involved. Sponsorship does not necessarily imply financial support, but it rather focuses on the provision of a project and access to data, information, and means to apply and test a solution. A personal or telephone interview of the applicant with the graduate program director will be required.

The minimum eligibility requirements for regular admission to the Doctor of Engineering program are: engineering experience of at least two years within the last five years and a master’s degree with a grade point average of 3.50 out of 4.00 in an appropriate field from an accredited institution of higher education.

Continuation and Graduation Requirements
The continuation requirements are the same as the continuation requirements for the Doctor of Philosophy programs. The graduation requirements for the Doctor of Engineering degree are as follows:

1. Satisfactory completion of a minimum of 48 credit hours of approved graduate work beyond the master’s degree, including the doctoral project.
2. Satisfactory performance on a diagnostic examination at the completion of nine credit hours of coursework. The purpose of this examination is to determine if the student has adequate background to pursue a doctoral degree. The diagnostic examination may only be repeated once.
3. Satisfactory completion of a written and oral candidacy examination. The student will take the candidacy examination when he/she is within six credit hours of completing all the required coursework. The candidacy examination may only be repeated once.
4. Preparation and successful defense of a project concept proposal. The student will be required to prepare and present a concept proposal related to the work that will be undertaken for the doctoral project. The concept proposal will be defended before the doctoral committee.
5. Submission of progress reports as deemed necessary by the doctoral committee.
6. Written report of the project results. The doctoral project shall be documented in a manner consistent with advanced, professional work. The project report will follow the standard format for Old Dominion University dissertations and theses.
7. Comprehensive oral defense of the doctoral project before the student’s doctoral committee and a general audience.

The applied doctoral project must successfully demonstrate the student’s mastery of the subject area and his/her ability to apply advanced technical knowledge to identify, formulate, and solve novel and complex engineering problems. The project must address a complex but practical problem currently faced by the public, industry, or government, and it must provide a solution that satisfies all the technical, social, political, economic, safety, sustainability, and environmental requirements and/or constraints. The doctoral project committee will have at least three Old Dominion University faculty members certified for graduate instruction; two faculty members must be from the major department. The committee must also have at least one non-University person with special knowledge of the project subject area.

Additional Graduate Degrees Policy
Graduate students may pursue an additional graduate degree in any discipline at Old Dominion University. Such a degree may be sought subsequent to or concurrently with another degree. Students may request that up to six credit hours of graduate level course work used to fulfill requirements for one Master’s degree offered by the Batten College of Engineering and Technology be applied to another Master’s program offered by the College. Approval of the appropriate graduate program directors and college dean is required. Course work used to fulfill requirements for another graduate degree cannot be applied to a doctoral degree offered by the Batten College of Engineering and Technology.
Interdisciplinary Graduate Certificate Programs

The college has established several certificate programs that enable students to specialize in technical areas of current interest to industry, government, and academia. Both non-degree and degree-seeking students can enroll in the certificate programs. The programs provide the opportunity for practicing engineers to further their knowledge and become more competent in their profession.

- The interdisciplinary Advanced Engineering Certificate Program offers the following tracks,
  - Biomedical Engineering
  - Cyber Systems Security
  - Energy Systems
  - Engineering Management
  - Naval Architecture and Marine Engineering
- Coastal Engineering Certificate
- Entrepreneurship and Innovation in Engineering Certificate
- Homeland Security Certificate
- Modeling and Simulation Engineering Certificate
- Project Management Certificate

Advanced Engineering Certificate in Biomedical Engineering

The Graduate Certificate in Biomedical Engineering Program offers students and professionals the opportunity to further their knowledge with advanced study in the growing area of Biomedical Engineering. The program is designed to provide well-rounded instruction in several key facets of Biomedical Engineering. Those who complete the Program receive the Advanced Engineering Certificate in Biomedical Engineering from Old Dominion University and a letter of recognition from the Batten College of Engineering and Technology. Courses taken for the certificate program may also be applied to the Ph.D. degree in Biomedical Engineering.

Certificate Program Admission Requirements

- Bachelor of Science degree (or equivalent) in an engineering field or undergraduate degree in another relevant STEM field.
- Prerequisites for applicants from non-engineering fields include college-level mathematics, calculus-based physics, and chemistry or biology.
- Students enrolled in the Biomedical Engineering Ph.D. or Master of Engineering programs at ODU are not eligible for the certificate.

Certificate Program Curriculum Requirements

- Twelve credit hours of graduate course work
- A grade point average of 3.0 or better

BME Fundamentals* 6
  - BME 501 Biomedical Engineering I: Principles
  - BME 502 Biomedical Engineering II: Applications

BME Electives (select two)** 6
  - BME 505 Biomechanics
  - BME 508 Microfluidics
  - BME 510 Biomedical Instrumentation
  - BME 554 Introduction to Bioelectronics
  - BME 630 Advanced Bioelectronics
  - BME 720 Modern Biomedical Instrumentation
  - BME 721 Quantitative Analysis of Human Physiological Systems I
  - BME 724 Neural Engineering
  - ECE 562 Introduction to Medical Image Analysis (MIA)

ECE 564 Biomedical Applications of Low Temperature Plasmas 12

* Students who have completed BME 401 or BME 402 as part of a previous degree, program, or minor may substitute these courses with graduate-level BME electives approved by the graduate program director.

** Appropriate course substitutions may be considered with permission of the graduate program director.

Advanced Engineering Certificate in Cyber Systems Security

The certificate program aims to provide a thorough understanding of the cyber security threats faced by the stand-alone computer systems, networked systems, IT infrastructure, and cyber physical systems having embedded computer systems operated by individuals, small businesses and large enterprises along with the knowledge required to defend against these threats. The course will enable participants to learn state of the art techniques necessary for analyzing cyber security risks, preventing, detecting and recovering from cyber attacks through class room instructions and hands-on lab work. The program uniquely accommodates students from engineering, math and sciences as well as practicing engineers and managers. The course will make use of the ODU’s multidisciplinary strengths in the fields of Cyber systems, Computer Engineering, Software Engineering and Modeling and Simulation. This program is designed both as a complement for students working on graduate degrees and for those personnel working on information and cyber systems used in industry, small businesses, healthcare, government, military and home land security. It is anticipated that students will complete the program in 2 semesters (full time enrollment) or 2 years (part-time enrollment) or working to complement an existing graduate program.

Certificate Program Admission Requirements

All applicants admitted to the certificate program must have earned a baccalaureate degree in engineering or a relevant STEM field from a regionally-accredited institution or an equivalent degree from a foreign institution. Prerequisites for applicants from non-engineering fields include college-level mathematics, calculus-based physics, and chemistry, health sciences and business. Those whose native language is not English must submit a minimum score of 230 on the computer-based TOEFL or 80 on the TOEFL iBT.

Certificate Program Curriculum Requirements

The Graduate Certificate in Cyber Security requires completion of 12 credit hours of graduate course work consisting of the following four courses:

- MSIM 570 Foundations of Cyber Security 3
- MSIM/ENMA 671 Cyber Systems Engineering 3
- MSIM/ENMA 672 Threat Modeling and Risk Analysis 3
- MSIM 773 Networked System Security 3

Total Hours 12

Advanced Engineering Certificate in Energy Systems

The Graduate Certificate in Energy Systems Engineering Program offers students and professionals the opportunity to further their knowledge with advanced study in the growing area of Energy Engineering. The program is aimed at providing understanding of energy engineering and the increasing role of energy engineers in addressing growing energy needs. The new skills and advanced understanding developed in class will prepare students for employment in rapidly growing energy industries.

Those who complete the Program receive the Advanced Engineering Certificate in Energy Systems Engineering from Old Dominion University and a letter of recognition from the Batten College of Engineering and Technology. Courses taken for the certificate program may also be applied.
to master’s level or doctoral graduate engineering programs at ODU, where they meet the program requirements.

Certificate Program Admission Requirements

- Baccalaureate degree in engineering—or a related field—from a regionally-accredited institution or an equivalent degree from a foreign institution.
- Those whose native language is not English must submit a minimum score of 230 on the computer-based TOEFL or 80 on the TOEFL iBT.

Certificate Program Curriculum Requirements

- Twelve credit hours of graduate course work
- A grade point average of 3.0 or better

<table>
<thead>
<tr>
<th>Energy Engineering Core Courses</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGN 671 Carbon-Free Clean Energy</td>
<td></td>
</tr>
<tr>
<td>ENGN 672 Energy Systems Management</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Engineering Electives (select two)*</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 513 Energy Conversion</td>
<td></td>
</tr>
<tr>
<td>CEE 559 Biofuels Engineering</td>
<td></td>
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<tr>
<td>ENGN 673 Fossil Energy</td>
<td></td>
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<tr>
<td>ENGN 697 Independent Study in Energy Engineering</td>
<td></td>
</tr>
<tr>
<td>ECE 772 Fundamentals of Solar Cells</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours 12

* Appropriate course substitutions may be considered with permission of the graduate program director.

Advanced Engineering Certificate in Engineering Management

This program provides the opportunity for practicing engineers to further their knowledge and become more competent in managing socio-technical systems. The certificate program is open to both degree-seeking and non-degree-seeking graduate students. Certain courses taken for the certificate program may later be applied to the master’s degree in Engineering Management for students that get formally admitted to the master in engineering management program. The Engineering Management Certificate Program consists of 12 credit hours of graduate level course work. The four courses comprising the certificate program are offered on a regular basis to enable the completion of the program in two years.

Graduate Certificate Admission Requirements

Admission to the program requires a Bachelor of Science degree in engineering (or equivalent). The certificate consists of four pre-approved graduate level courses contributing to an emphasis area that can be interdisciplinary. A grade point average of 3.0 or better is required to earn the certificate.

For more information please contact:

Graduate Program Director for Master Programs (http://catalog.odu.edu/graduate/frankbattencollegeofengineeringandtechnology/engineeringmanagementsystemsengineering)
Old Dominion University
2101 Engineering Systems Building
Norfolk, VA 23529

Graduate Certificate Course Requirements

The Graduate Certificate in Engineering Management requires the completion of 12 credit hours at the graduate level. The courses are offered via distance learning. The four courses can be selected from the following list*:

| ENMA 600 | Cost Estimating and Financial Analysis   | 3 |
| ENMA 601 | Analysis of Organizational Systems       | 3 |
| ENMA 603 | Operations Research                      | 3 |

An overall GPA of 3.00 or better is required to earn the graduate certificate in Engineering Management.

Advanced Engineering Certificate in Naval Architecture and Marine Engineering

In order to provide the opportunity for practicing engineers to further their knowledge and to become more competent in the fields of Naval Architecture and Marine Engineering, the Department of Mechanical and Aerospace Engineering offers a non-degree graduate level certificate program in Naval Architecture and Marine Engineering. Admission to the program requires a Bachelor of Science degree (or equivalent) in Mechanical Engineering, Aerospace Engineering, Naval Architecture and Marine Engineering, or a related field. The students must complete four 3-credit graduate-level courses to earn a certificate. The certificate program credits will be transferable to the Master’s degree programs in Mechanical and Aerospace Engineering. The certificate program offers two tracks:

1. Naval Architecture
2. Marine Engineering

To meet the requirements of either track, students must complete a common required course, Engineering Mathematics or MAE 608, Applied Mathematics for Engineers and three 3-credit courses described below.

Naval Architecture Track:

Required

| MAE 450/550 | Principles of Naval Architecture | 3 |

Select two from the following:

| MAE 788/888 | Computational Intelligence for Engineering Design Optimization Problems | 6 |
| MAE 695    | Topics in Mechanical and Aerospace Engineering ((Numerical Marine Hydrodynamics)) |   |
| MAE 695    | Topics in Mechanical and Aerospace Engineering ((Ship Resistance and Propulsion)) |   |
| MAE 695    | Topics in Mechanical and Aerospace Engineering ((Ship Resistance and Propulsion)) |   |
| MAE 695    | Topics in Mechanical and Aerospace Engineering ((Dynamics of Marine Crafts)) |   |
| MAE 695    | Topics in Mechanical and Aerospace Engineering ((Marine Structures)) |   |

Marine Engineering Track:

Required

| MAE 511    | Mechanical Engineering Power Systems Theory and Design | 3 |

Select two from the following:

| MAE 512    | Environmental Control |   |
| MAE 517    | Propulsion Systems    |   |
| MAE 602    | Fluid Dynamics and Aerodynamics |   |
| MAE 722/822| Theory and Design of Turbomachines |   |

Coastal Engineering Certificate

In order to provide the opportunity for practicing civil/coastal engineers to further their knowledge and to become more competent in their profession, the Department of Civil and Environmental Engineering offers a non-degree Coastal Engineering Certificate. Admission to the program requires a Bachelor of Science degree (or equivalent) in civil engineering, coastal engineering, or a related field (e.g. oceanography, geoscience). The program
consists of the following four graduate courses (12 credit hours) that are taught over the course of two years (one each semester); these courses are made available on-line.

**Certificate Program Admission Requirements**

Admission to the program requires a Bachelor of Science degree (or equivalent) in civil engineering, coastal engineering, or a related field (e.g. oceanography, geoscience).

**Certificate Program Curriculum Requirements**

The program consists of the following four graduate courses (12 credit hours) that are taught over the course of two years (one each semester); these courses are made available on-line.

- **CEE 582** Introduction to Coastal Engineering 3
- **CEE 782** Design of Coastal Structures 3
- **CEE 787** Dredging and Beach Engineering 3
- **CEE 788** Coastal Hydrodynamics and Sediment Processes 3

**Total Hours** 12

An overall grade point average of 3.00 or better is required to earn the certificate.

**Entrepreneurship and Innovation in Engineering Certificate**

Entrepreneurship and innovation are expected to be primary forces in the creation of new business ventures that drive growth and progress in the worldwide economy. Experienced engineering professionals pursuing this certificate may seek to implement their ideas in a multitude of organizational structures. Many may seek outlets outside their current work environments where they can bring their ideas to fruition.

This certificate program provides an integrated approach to teaching, mentoring and encouraging engineering professionals. It introduces engineering students and students from other disciplines with an engineering background to a wide range of entrepreneurial approaches. The certificate’s content addresses the formation of start-up ventures, the growth of existing ventures, and the continued viability of mature, technical enterprises.

**Graduate Certificate Admission Requirements**

All applicants admitted to the certificate program must have earned a baccalaureate degree from a regionally-accredited institution or an equivalent degree from a foreign institution. Those whose native language is not English must submit a minimum score of 230 on the computer-based TOEFL or 80 on the TOEFL iBT.

**Graduate Certificate Course Requirements**

The Graduate Certificate in Entrepreneurship and Innovation in Engineering requires the completion of the courses listed below totaling 12 credit hours at the graduate level.

- **ENGN 620** The Entrepreneurial Engineer 2
- **ENGN 621** The Entrepreneurial Engineer 2
- **ENGN 623** Leadership and Human Dynamics for the Entrepreneurial Engineer 2
- **Marketing and Sales Management for Entrepreneurs** 2
- **Operations and Supply Chain Management for Entrepreneurs** 2
- **Financial Management for Entrepreneurs** 2

**Total Hours** 12

* New Strome College of business courses

An overall grade point average of 3.0 or better is required to earn the certificate.

**Homeland Security Certificate**

The Homeland Security Certificate Program consists of 12 credit hours of graduate level course work that can be taken across colleges. The four courses comprising the certificate program are offered on a regular schedule to enable the completion of the program in two years. The program provides the opportunity for students to further their knowledge in Homeland Security from a systems perspective and become more competent in their respective profession.

**Graduate Certificate Admission Requirements**

Admission to the program requires a Bachelor’s degree (or equivalent). The program will consist of three tracks, with courses taught in the Batten College of Engineering and Technology, Strome College of Business, and the College of Arts and Letters. An overall grade point average of 3.0 or better is required to earn the certificate.

Please refer to the Engineering Management and System Engineering Graduate Program Director (https://www.odu.edu/directory/people/c/cpinto) for more information.

**Graduate Certificate Course Requirements**

The Graduate Certificate in Engineering Management requires the completion of 12 credit hours at the graduate level.

**Required**

- **ENMA 724** Risk Analysis 3
- **ENMA 771** Risk and Vulnerability Management of Complex Interdependent Systems 3
- **ENMA 715** Systems Analysis 3

**Select one from the following**

- **ENMA 670** Cyber Systems Engineering 3
- **ENMA 695** Topics in Engineering Management ((Mission Engineering))
- **PORT 612** Port Operations and Management
- **PORT 614** Port Planning and Economics 3
- **IS 701/801** Global Change and American Foreign Policy
- **IS 702/802** Approaches to Collective Security
- **IS 706/806** The Causes of War
- **IS 707/807** Interdependence, Power, and Transnationalism
- **IS 720/820** Research Seminar in Global Security
- **IS 740/840** Political Economy of Development
- **IS 795/895** Topics in International Studies
- **CRJS 575** Criminal Justice Systems Around the World

**Total Hours** 12

* Students may elect to take ENMA 714 (Crisis Project Management) in place of ENMA 724 with prior approval from graduate program director.

**Students may elect to take other elective courses with prior approval from graduate program director.**

**Graduate Certificate in Modeling and Simulation Engineering**

The Graduate Certificate in Modeling and Simulation Engineering is designed for those who meet the admission requirements of the modeling and simulation master's program and wish to broaden their knowledge of modeling and simulation related principles and practices without pursuing a graduate degree. This is a 12 credit hour non-degree program offered by the Department of Modeling Simulation and Visualization Engineering. The certificate program is open to both degree-seeking and non-degree-seeking graduate students. Certain courses taken for the certificate program may later be applied to the master's degree in modeling and simulation.

**Graduate Certificate Admission Requirements**

Students should have either an undergraduate degree from a regionally accredited institution and should have a mathematical background through calculus, along with a calculus based probability and statistics course. Students should submit a graduate non-degree application through the Office of Admissions, and then submit a departmental application with
copies of unofficial transcripts from all previous coursework to the MSVE Department. Departmental applications are available online on the MSVE Department’s website – http://eng.odu.edu/msve - and should be sent to:

Academic Advisor and Program Manager
MSVE Department
Old Dominion University
1300 Engineering and Computational Sciences Building
Norfolk, VA 23529

Graduate Certificate Course Requirements
The Graduate Certificate in Modeling and Simulation Engineering requires the completion of 12 credit hours at the graduate level. The course requirements are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSIM 601</td>
<td>Introduction to Modeling and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>MSIM 602</td>
<td>Simulation Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>One course from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSIM 510</td>
<td>Model Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MSIM 541</td>
<td>Computer Graphics and Visualization</td>
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</tr>
<tr>
<td>MSIM 551</td>
<td>Analysis for Modeling and Simulation</td>
<td></td>
</tr>
<tr>
<td>MSIM 603</td>
<td>Simulation Design</td>
<td></td>
</tr>
<tr>
<td>MSIM ELE - MSIM Elective*</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Total Hours: 12

* A graduate level elective approved by the graduate program director. This elective may be an MSIM course or from another discipline outside of modeling and simulation. It is possible that this course may be outside the discipline of modeling and simulation, but approved because it complements the field of M&S and the student’s interests.

An overall GPA of 3.00 or better is required to earn the graduate certificate in modeling and simulation engineering.

Project Management Certificate
The project management graduate certificate program is designed to facilitate learning essential and contemporary concepts, tools, and processes to manage projects in modern organizations. Courses in the program cover a mix of technical and human topics that are needed for successful project management. Students looking to enroll in the certificate program must meet the admission requirements of Old Dominion University at the graduate level to obtain the Graduate Certificate in Project Management. Certain courses taken for the certificate program may later be applied to the master’s degree in Engineering Management for students that get formally admitted to the master in engineering management program. The graduate certificate in Project Management consists of 12 credit hours of graduate level course work. The four courses comprising the certificate program are offered on a regular basis to enable the completion of the program in two years.

Graduate Certificate Admission Requirements
Admission to the program requires a Bachelor of Science degree in engineering (or equivalent). The certificate consists of four pre-approved graduate level courses contributing to an emphasis area that can be interdisciplinary. A grade point average of 3.0 or better is required to earn the certificate.

Graduate Certificate Course Requirements
The Graduate Certificate in Engineering Management requires the completion of 12 credit hours at the graduate level. The courses are offered via distance learning. The four required courses are listed below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENMA 604</td>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>ENMA 780</td>
<td>Leadership for Engineering Managers</td>
<td>3</td>
</tr>
<tr>
<td>ENMA 410/510</td>
<td>Agile Project Management</td>
<td>3</td>
</tr>
<tr>
<td>ENMA 700/800</td>
<td>Economic Analysis of Capital Projects</td>
<td>3</td>
</tr>
</tbody>
</table>

Optional