ENGINEERING, MASTER OF SCIENCE (M.S.) WITH A CONCENTRATION IN ARTIFICIAL INTELLIGENCE

Program mission

The mission of the M.S. in Engineering degree is to provide graduate students with learning opportunities for acquiring a broad foundation of engineering knowledge including business and manufacturing aspects; an in-depth research experience at the frontiers of engineering; and skills for lifelong learning and professional development. Graduates of this program will pursue careers in business/industry and government, or will pursue doctoral degrees.

1. Advanced research skills: To produce graduates who possess the necessary advanced analytical, technical and research skills in engineering and the sciences – responds directly to the higher goal of fulfilling the needs of industry, academe and research laboratories for effective, productive engineers, professors and researchers
2. Communication: To produce graduates who possess a facility with both written and oral communications – emanates from the requirement that engineers, researchers and professors must be able to interact and share ideas with others in the work environment, and at a higher level, be capable of creative self-expression, conveying knowledge and leadership
3. Advanced problem-solving: To produce graduates who demonstrate creativity and innovation in solving technological problems – stems from the realization that new knowledge and new solutions to existing problems are necessary to meet the needs of our changing society and to advance the quality of human life

Student learning outcomes

1. Apply advanced knowledge of mathematics, science or engineering: Graduates will demonstrate an ability to apply advanced knowledge of mathematics, science or engineering.
2. Communicate effectively: Graduates will demonstrate an ability to communicate effectively.
3. Identify, formulate and solve engineering problems: Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
4. Analyze and synthesize knowledge: Graduates will demonstrate knowledge within the field of artificial intelligence to help develop practical solutions to address societal challenges.

VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the Graduate School website (http://www.graduate.vcu.edu/) and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

Visit the academic regulations section for additional information on academic regulations for graduate students. (https://bulletin.vcu.edu/academic-regs/)

Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

Visit the academic regulations section for additional information on degree candidacy requirements. (https://bulletin.vcu.edu/academic-regs/grad/candidacy/)

Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

Visit the academic regulations section for additional information on graduation requirements. (https://bulletin.vcu.edu/academic-regs/grad/graduation-info/)

Apply online today. (https://www.vcu.edu/admissions/apply/graduate/)

In addition to the general admission requirements of the VCU Graduate School (https://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements/)and the College of Engineering, applicants to the artificial intelligence concentration must satisfy the undergraduate course work requirements in computer science or in a related discipline is highly preferred.

Degree requirements

In addition to the VCU Graduate School graduation requirements (https://bulletin.vcu.edu/academic-regs/grad/graduation-info/), students must meet the following requirements.

Thesis option

Students seeking the M.S. degree are required to take a minimum of 30 credit hours of approved graduate courses (including research). Each student must complete 12 credit hours in concentration course work, 9 credit hours in concentration electives, 3 credits in open electives, and a minimum of 6, but up to a maximum of 9, credit hours in thesis research. The student's adviser must review and approve all course work and thesis research credit hours. At least half of the didactic credit hours required in the student's program must be those designated as exclusively for graduate students, that is, those at the 600 level or above. A GPA of 3.0 at the time of completion is required for graduation. Students may not present courses receiving grades less than C for fulfilling degree requirements and can only present up to six credit hours of course work receiving a grade of C.

Each student must conduct an original investigation under the supervision of the permanent adviser and prepare a thesis reporting the results of this research and analyzing its significance in relation to existing scientific knowledge. This study is reported in a thesis prepared in acceptable form and style. Upon approval of the thesis by the adviser, the student submits a copy to each member of the advisory committee. The student's advisory committee members examine the thesis and decide upon its acceptability. Each committee member reports to the student's adviser when the thesis is acceptable for defense. The thesis is approved for defense only if accepted unanimously. Upon approval of the thesis, the student appears for a final oral examination administered by the student's advisory committee. This examination of an M.S. candidate includes the subject matter of course work as well as the thesis.

Non-thesis option

Students seeking the non-thesis M.S. degree are required to take a minimum of 30 credit hours of approved graduate courses. Each student must complete 12 credit hours in concentration course work, 15 credit hours in concentration electives, and 3 credits in open electives.

At least half of the didactic credit hours required in the student's program must be those designated as exclusively for graduate students, that is, those at the 600 level or above. A GPA of 3.0 at the time of completion is required for graduation. Students may not present courses receiving grades less than C for fulfilling degree requirements and can only present up to six credit hours of course work receiving a grade of C.

Curriculum Requirements

Thesis option[1]

Course	Title	Hours
Required graduate-level coursework		
Engineering or other relevant graduate course work from 500-level or higher courses in CMSC, EGRE, ENGR, EGRB, EGMN or CLSE approved by the advisory committee OR CMSC 697		3
Concentration component		**12**
CMSC 516	Advanced Natural Language Processing	
CMSC 606	Introduction to Machine Learning	
CMSC 627	Human-AI Interaction	
CMSC 636	Artificial Neural Networks and Deep Learning (Concentration component)	
Concentration electives		
Elective graduate course work in artificial intelligence selected from the list below		9
CMSC 531	3D Computer Vision for Robot Navigation	
CMSC 535	Introduction to Data Science	
CMSC 603	High Performance Distributed Systems	
CMSC 608	Advanced Database	
CMSC 626	Software Engineering for AI-Enabled Systems	
CMSC 630	Image Analysis	
CMSC 635	Knowledge Discovery and Data Mining	
CMSC 637	Graph Representation Learning	
CMSC 638	Quantum Machine Learning	
EGRB 528	Fundamentals and Applications of Artificial Intelligence in Medical Imaging	
EGRB 534	Artificial Intelligence in Rehabilitation Engineering	
EGRE 512	Intelligent Autonomous Systems	
EGMN 561	Artificial Intelligence in Mechanical and Nuclear Engineering	
CMSC 697	Directed Research	6
Total Hours		**30**

1

The thesis option can be tailored to meet the individual student's academic goals and research interests. Students seeking to take course work and conduct their research in the artificial intelligence concentration should contact the graduate program coordinator for detailed information about the concentration.

The minimum number of graduate credit hours required for this degree is 30.

Non-thesis option[1]

Course	Title	Hours
Required graduate-level coursework		
Engineering or other relevant graduate course work from 500-level or higher courses in CMSC, EGRE, ENGR, EGRB, EGMN or CLSE approved by the advisory committee		3
Concentration component		**12**
CMSC 516	Advanced Natural Language Processing	
CMSC 606	Introduction to Machine Learning	
CMSC 627	Human-AI Interaction	
CMSC 636	Artificial Neural Networks and Deep Learning (Concentration component)	
Concentration electives		
Elective graduate course work in artificial intelligence selected from the list below		15
CMSC 531	3D Computer Vision for Robot Navigation	
CMSC 535	Introduction to Data Science	
CMSC 603	High Performance Distributed Systems	
CMSC 608	Advanced Database	
CMSC 626	Software Engineering for AI-Enabled Systems	

CMSC 630	Image Analysis	
CMSC 635	Knowledge Discovery and Data Mining	
CMSC 637	Graph Representation Learning	
CMSC 638	Quantum Machine Learning	
EGRB 528	Fundamentals and Applications of Artificial Intelligence in Medical Imaging	
EGRB 534	Artificial Intelligence in Rehabilitation Engineering	
EGRE 512	Intelligent Autonomous Systems	
EGMN 561	Artificial Intelligence in Mechanical and Nuclear Engineering	
Total Hours		**30**

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The non-thesis option can be tailored to meet the individual student's academic goals and research interests.

The minimum number of graduate credit hours required for this degree is 30.

Students who complete the requirements for this degree will receive a Master of Science in Engineering.

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