SOFTWARE ENGINEERING, MS

Banner Code: VS-MS-SWE

Academic Advising

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The MS provides specialized knowledge and experience in developing and modifying large, complex software systems. It emphasizes technical and management aspects of software engineering development. Software engineering is an established discipline based on requirements analysis, design, construction, testing, maintenance, economics, and management issues. A pragmatic approach to problem solving is the hallmark of a software engineer. Software engineers are concerned with the theoretical and practical aspects of technology, cost, and social impact of software systems that are effective and efficient.

Software engineers are in demand in every segment of society affected by computing technology. Potential employers include all software vendors and Internet-based companies, electronic business organizations, businesses that build and sell computers, research and development laboratories, aerospace companies, government contractors, banks, insurance companies, and manufacturing organizations. The master's program is concerned with technical and managerial issues, but primary emphasis is placed on the technical aspects of building and modifying high-quality software systems.

Successful applicants have a broad variety of undergraduate backgrounds, including computer science, science and mathematics, engineering, liberal arts, and business. Many students are working or have worked in the software industry.

The program is revised on a regular basis to stay abreast of the latest developments in information technology (IT). The program introduced a major revision for fall 2005; recent additions include software construction with the object-oriented Java programming language, requirements analysis with use cases and the Unified Modeling Language (UML), object-oriented software design with the UML, graphical user interface design, software engineering for the web, software project management using the spiral life cycle model and the Capability Maturity Model, software architecture, design patterns, system testing and testing of object-oriented components, and formal methods using the Object Constraint Language. All classes are scheduled in the late afternoon and early evening to accommodate employed students.

Admissions & Policies

Admissions

Students entering the MS program must have coursework or equivalent knowledge in the following areas: introductory programming in any language; knowledge of an object-oriented programming language such as Java, C++, or C#; data structures and algorithms; machine organization (such as those given in computer system architecture or assembly language courses); and topics in discrete mathematics, including sets, relations, functions, trees, graphs, and inductive proofs.

The level of knowledge required in these areas is equivalent to that taught in undergraduate courses and may be achieved by taking the following foundation courses from Mason:

INFS 501	Discrete and Logical Structures for Information Systems	3
INFS 515	Computer Organization Course and Operating Systems	3
INFS 519	Program Design and Data Structures	3
SWE 510	Object-Oriented Programming in Java	3
Total Credits		12

In addition, it is desirable, though not required, that entering students have at least one year of work experience in building or modifying software systems.

Prospective students are asked to complete a department self-evaluation form, indicating whether previously taken courses may satisfy these foundation requirements. On acceptance, students are advised of the necessary foundation courses to be satisfactorily completed to meet this requirement. Foundation courses do not earn credit toward the MS degree; however, they must be successfully completed with a grade of B or better before enrolling in the core curriculum.

Students may test out to indicate they have the requisite knowledge for those foundation courses. The exams are given before classes begin in January and August, and can only be taken once. Registration is not required; students need only be present at the date, time, and location specified and bring some form of photographic identification. Detailed information is available on the department web site. Students failing any one of the exams must take the equivalent course before enrolling in the core curriculum courses.

Application Requirements

In addition to general admission requirements of the university, each applicant to the MS program must hold a four-year (120-credit) baccalaureate degree in an appropriate discipline from an accredited institution and have earned a GPA of 3.00 or better in the last 60 credits of undergraduate study. Other requirements are as follows:

- Provide a resume and a one- to two-page statement of educational and work experience in the computing field that includes a statement of career goals in software engineering.
- Complete the self-evaluation section of the online application. This information is used by the admissions committee to assess an applicant's academic preparation for the MS program. Students with some deficiencies in preparation may be admitted provisionally pending completion of foundation courses required for the program.
- Submit the appropriate application with two letters of recommendation from people directly knowledgeable of the applicant's professional and academic competence.
- The GRE is only required for those who have not earned a Bachelor's degree from a US Institution.
- International students must submit their English Proficiency scores.

Acceptance into the MS program is based on an overall assessment of the applicant's ability to complete the program of study satisfactorily. Well-qualified students with minor deficiencies may be admitted to

the program in provisional status, with specified course work to be completed within a specified time.

Policies

Program Requirements

In addition to the general requirements of the university, the MS in Software Engineering requires a minimum of 30 graduate credits. The coursework is divided into three categories: a breadth requirement of 12 credits of core courses, a depth requirement of 9 credits of emphasis courses, and 9 credits of elective courses.

Advising

The department holds orientation meetings each January and August to advise incoming and continuing students. Members of the faculty are present to answer questions and offer advice concerning programs of study. Detailed information is available on the department web site.

The department also provides an advising function to students, as outlined in the student advising form available from the department. Each student is assigned a faculty advisor with whom to confer on matters related to degree requirements. A plan of study form for the MS degree should be completed and submitted by the student soon after admission; this plan serves as a guide for the student.

Requirements

Degree Requirements

Total credits: 30

Core Courses

SWE 619	Object-Oriented Software Specification and Construction	3
SWE 621	Software Modeling and Architectural Design	3
SWE 622	Distributed Software Engineering	3
SWE 637	Software Testing	3
Total Credits		12

Emphasis Courses

Students may choose an emphasis by taking three courses from one of the available emphasis areas. With permission from the advisor, a student may choose to not take an emphasis.

Select an emphasis by taking three courses from one of the following areas:	9
Software Design	
Secure Software Engineering	
Software Management	
Web Applications Design and Development	
Total Credits	9

Software Design

SWE 626	Software Project Laboratory	3
SWE 632	User Interface Design and Development	3
SWE 681	Secure Software Design and Programming	3
SWE 721	Reusable Software Architectures	3

SWE 722	Service Oriented Architecture	3
SWE 727	Quality of Service for Software Architectures	3
SWE 760	Software Analysis and Design of Real-Time Systems	3

Secure Software Engineering

ISA 562	Information Security Theory and Practice	3
SWE 642	Software Engineering for the World Wide Web	3
SWE 681	Secure Software Design and Programming	3
SWE 737	Advanced Software Testing	3
ISA 673	Operating Systems Security	3

Software Management

OR 540	Management Science	3
SWE 620	Software Requirements Analysis and Specification	3
SWE 625	Software Project Management	3
SWE 626	Software Project Laboratory	3
ISA 650	Security Policy	3

Web Applications Design and Development

INFS 614 or CS 550	Database Management [1] Database Systems	3
SWE 632	User Interface Design and Development	3
SWE 642	Software Engineering for the World Wide Web	3
SWE 645	Component-Based Software Development	3
SWE 722	Service Oriented Architecture	3
SWE 737	Advanced Software Testing	3

[1] Note: Credit will not be given for both INFS 614 Database Management and CS 550 Database Systems

Electives

Students may select the remaining courses from the list of approved elective courses, including other emphasis areas and courses from other MS programs in the department and the Volgenau School. Students may choose other graduate electives with the consent of their faculty advisor and the graduate coordinator. Students, with the consent of a faculty sponsor and faculty advisor, may also elect courses in individualized study, special topics, or a 6-credit thesis, which is primarily intended for students planning to pursue a PhD in Information Technology with a concentration in Software Engineering.

Select 9 credits from the list of approved elective courses or from the following:	9
SWE 699 Special Topics in Software Engineering	
SWE 795 Advanced Topics in Software Engineering	
SWE 796 Directed Readings in Software Engineering	
SWE 798 Research Project	
SWE 799 Thesis	
Total Credits	9

Approved Electives

Below is the list of approved electives organized by academic program. Students should note that a maximum of two 500-level courses are allowed as electives. Courses not on this list may only be taken with explicit signed permission from the MS-SWE advisor.

Information Systems (INFS)

INFS 612	Principles and Practices of Communication Networks	3
INFS 614	Database Management	3
INFS 623	Web Search Engines and Recommender Systems	3
INFS 640	Introduction to Electronic Commerce	3
INFS 697	Topics in Information Systems	1-6
INFS 740	Database Programming for the World Wide Web	3
INFS 760	Advanced Database Management	3
INFS 770	Knowledge Management for E-Business	3
INFS 772	Intelligent Agents and the Semantic Web	3
INFS 774	Enterprise Architecture	3
INFS 797	Advanced Topics in Information Systems	1-6

Information Security and Assurance (ISA)

ISA 562	Information Security Theory and Practice	3
ISA 564	Security Laboratory	3
ISA 650	Security Policy	3
ISA 652	Security Audit and Compliance Testing	3
ISA 656	Network Security	3
ISA 673	Operating Systems Security	3
ISA 681	Secure Software Design	3
ISA 697	Topics in Information Security	1-6
ISA 763	Security Protocol Analysis	3
ISA 764	Security Experimentation	3
ISA 785	Research in Digital Forensics	3
ISA 797	Advanced Topics in Information Security	3

Software Engineering (SWE)

SWE 620	Software Requirements Analysis and Specification	3
SWE 625	Software Project Management	3
SWE 626	Software Project Laboratory	3
SWE 631	Software Design Patterns	3
SWE 632	User Interface Design and Development	3
SWE 642	Software Engineering for the World Wide Web	3
SWE 645	Component-Based Software Development	3
SWE 681	Secure Software Design and Programming	3
SWE 699	Special Topics in Software Engineering	3
SWE 721	Reusable Software Architectures	3
SWE 727	Quality of Service for Software Architectures	3
SWE 737	Advanced Software Testing	3
SWE 760	Software Analysis and Design of Real-Time Systems	3
SWE 763	Software Engineering Experimentation	3
SWE 795	Advanced Topics in Software Engineering	3
SWE 796	Directed Readings in Software Engineering	3
SWE 798	Research Project	3
SWE 799	Thesis	1-6

Computer Science (CS)

CS 531	Fundamentals of Systems Programming	3
CS 540	Language Processors	3
CS 550	Database Systems	3
CS 555	Computer Communications and Networking	3
CS 571	Operating Systems	3
CS 580	Introduction to Artificial Intelligence	3
CS 583	Analysis of Algorithms	3
CS 584	Theory and Applications of Data Mining	3
CS 611	Computational Methods for Genomics	3
CS 630	Advanced Algorithms	3
CS 635	Foundations of Parallel Computation	3
CS 640	Advanced Compilers	3
CS 650	Advanced Database Management	3
CS 657	Mining Massive Datasets with MapReduce	3
CS 662	Computer Graphics Game Technologies	3
CS 672	Computer System Performance Evaluation	3
CS 673	Multimedia Computing and Systems	3
CS 674	Data Mining on Multimedia Data	3
CS 681	Knowledge Engineering	3
CS 682	Computer Vision	3
CS 683	Parallel Algorithms	3
CS 684	Graph Algorithms	3
CS 685	Autonomous Robotics	3
CS 686	Image Processing and Applications	3
CS 687	Advanced Artificial Intelligence	3
CS 688	Pattern Recognition	3
CS 689	Planning Motions of Robots and Molecules	3
CS 700	Quantitative Methods and Experimental Design in Computer Science	3
CS 706	Concurrent Software Systems	3
CS 752	Interactive Graphics Software	3
CS 755	Advanced Computer Networks	3
CS 756	Performance Analysis of Computer Networks	3
CS 773	Real-Time Systems Design and Development	3
CS 777	Human-Computer Intelligent Interaction	3
CS 779	Topics in Resilient and Secure Computer Systems	3
CS 782	Machine Learning	3
CS 787	Decision Guidance Systems	3

| CS 795 | Advanced Topics in CS | 3 |

Electrical and Computer Engineering (ECE)

ECE 511	Microprocessors	3
ECE 521	Modern Systems Theory	3
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	3
ECE 535	Digital Signal Processing	3
ECE 537	Introduction to Digital Image Processing (DIP)	3
ECE 542	Computer Network Architectures and Protocols	3
ECE 545	Digital System Design with VHDL	3
ECE 548	Sequential Machine Theory	3
ECE 584	Semiconductor Device Fundamentals	3
ECE 586	Digital Integrated Circuits	3
ECE 611	Advanced Microprocessors	3
ECE 612	Real-Time Embedded Systems	3
ECE 620	Optimal Control Theory	3
ECE 621	Systems Identification	3
ECE 624	Control Systems	3
ECE 630	Statistical Communication Theory	3
ECE 633	Coding Theory	3
ECE 635	Adaptive Signal Processing	3
ECE 641	Computer System Architecture	3
ECE 642	Design and Analysis of Computer Communication Networks	3
ECE 643	Network Switching and Routing	3
ECE 645	Computer Arithmetic	3
ECE 646	Cryptography and Computer Network Security	3
ECE 650	Robotics	3
ECE 680	Physical VLSI Design	3
ECE 681	VLSI Design for ASICs	3
ECE 732	Mobile Communication Systems	3
ECE 741	Wireless Networks	3
ECE 746	Advanced Applied Cryptography	3

Operations Research (OR)

OR 540	Management Science	3
OR 541	Operations Research: Deterministic Models	3
OR 542	Operations Research: Stochastic Models	3
OR 635	Discrete System Simulation	3
OR 640	Global Optimization and Computational Intelligence	3
OR 641	Linear Programming	3
OR 642	Integer Programming	3
OR 643	Network Modeling	3
OR 644	Nonlinear Programming	3
OR 645	Stochastic Processes	3
OR 647	Queuing Theory	3
OR 681	Decision and Risk Analysis	3
OR 690	Optimization of Supply Chains	3

Psychology (PSYC)

| PSYC 734 | Seminar in Human Factors and Applied Cognition | 3 |

Statistics (STAT)

STAT 544	Applied Probability	3
STAT 554	Applied Statistics I	3
STAT 652	Statistical Inference	3
STAT 655	Analysis of Variance	3
STAT 656	Regression Analysis	3
STAT 662	Multivariate Statistical Methods	3
STAT 663	Statistical Graphics and Data Exploration I	3
STAT 674	Survey Sampling II	3

Systems Engineering (SYST)

SYST 542	Decision Support Systems Engineering	3
SYST 560	Introduction to Air Traffic Control	3
SYST 573	Decision and Risk Analysis	3
SYST 611	System Methodology and Modeling	3
SYST 620	Discrete Event Systems	3
SYST 659	Topics in Systems Engineering	3
SYST 660	Air Transportation Systems Modeling	3
SYST 671	Judgment and Choice Processing and Decision Making	3
SYST 680	Principles of Command, Control, Communications, Computing, and Intelligence (C4I)	3
SYST 683	Modeling, Simulation, and Gaming	3

Accelerated Master's

Applied Computer Science, BS/Software Engineering, Accelerated MS

Overview

Highly-qualified students in the Applied Computer Science, BS have the option of obtaining an accelerated Software Engineering, MS. See AP.6.7 Bachelor's/Accelerated Master's Degrees.

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies.

Admission Requirements

Students in the Applied Computer Science, BS program may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30. Students must have successfully completed:

Code	Title	Credits
CS 310	Data Structures	3
CS 330	Formal Methods and Models	3
CS 367	Computer Systems and Programming	4
Total Credits		10

Accelerated Option Requirements

Students must complete all credits that satisfy requirements for the BS and MS programs, with 6 credits overlap.

Students register for two 500-level computer science core courses (6 credits) in place of the corresponding 400-level computer science courses, as part of the undergraduate degree requirements. Specifically, students must take:

Code	Title	Credits
CS 583	Analysis of Algorithms	3
Select one of the following:		3
CS 540	Language Processors	
CS 550	Database Systems	
CS 551	Computer Graphics	
CS 555	Computer Communications and Networking	
CS 571	Operating Systems	
CS 580	Introduction to Artificial Intelligence	
CS 584	Theory and Applications of Data Mining	
Total Credits		6

Note:

Students complete all Software Engineering, MS core courses and apply the two courses from the above list toward the elective requirements.

Degree Conferral

Students must apply the semester before they expect to complete the BS requirements to have the BS degree conferred. In addition, at the beginning of the student's final undergraduate semester, students must complete a Bachelor's/Accelerated Master's Transition form that is submitted to the Office of the University Registrar and the VSE Graduate Admissions Office. At the completion of MS requirements, a master's degree is conferred.

Computer Science, BS/Software Engineering, Accelerated MS
Overview

Highly-qualified students in the Computer Science, BS have the option of obtaining an accelerated Software Engineering, MS.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

Admission Requirements

Students in the Computer Science, BS program may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30. Students must have successfully completed CS 310 Data Structures, CS 330 Formal Methods and Models and CS 367 Computer Systems and Programming.

Accelerated Option Requirements

Students must complete all requirements for the BS and MS programs, with 6 credits overlap. Students register for 6 credits of CS 500-level basic courses in place of the corresponding CS 400-level courses required for the undergraduate degree requirements. Specifically,

students must register for two of the following courses in place of the corresponding 400-level courses:

Code	Title	Credits
CS 540	Language Processors	3
CS 550	Database Systems	3
CS 551	Computer Graphics	3
CS 555	Computer Communications and Networking	3
CS 571	Operating Systems	3
CS 580	Introduction to Artificial Intelligence	3
CS 583	Analysis of Algorithms	3
CS 584	Theory and Applications of Data Mining	3

Note:

Students complete all MS in Software Engineering core courses and apply the two courses from the above list toward the elective requirements.

Degree Conferral

Students must apply the semester before they expect to complete the BS requirements to have the BS degree conferred. In addition, at the beginning of the student's final undergraduate semester, students must complete a Bachelor's/Accelerated Master's Transition form that is submitted to the Office of the University Registrar and the VSE Graduate Admissions Office. At the completion of MS requirements, a master's degree is conferred.

Information Technology, BS/Software Engineering, Accelerated MS
Overview

Highly-qualified students in the Information Technology, BS have the option of obtaining an accelerated Software Engineering, MS.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

Admission Requirements

Students in the Information Technology, BS program may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30. Criteria for admission are identical to criteria for admission to the Software Engineering, MS Program.

Accelerated Option Requirements

Students must complete all credits that satisfy requirements for the BS and MS programs, with 6 credits overlapping with the following two courses:

Code	Title	Credits
CS 550	Database Systems (satisfies IT 414 requirement in the BS program)	3
SWE 619	Object-Oriented Software Specification and Construction (satisfies as one DTP concentration course in the BS program)	3

Note:

Students must complete MATH 125 Discrete Mathematics I (Mason Core) as their discrete math requirement and IT 306 Program Design and Data Structures as part of their concentration requirements in the BS program

Degree Conferral

Students must apply the semester before they expect to complete the BS requirements to have the BS degree conferred. In addition, at the beginning of the student's final undergraduate semester, students must complete a Bachelor's/Accelerated Master's Transition form that is submitted to the Office of the University Registrar and the VSE Graduate Admissions Office. At the completion of MS requirements, a master's degree is conferred.