INFORMATION TECHNOLOGY, PHD

Banner Code: VS-PHD-INFT

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The Information Technology (INFT) PhD is a signature degree of the Volgenau School of Engineering. The program focuses on the science, engineering, and technology of information processing, an area of study ripe for innovation in a world driven more and more by data. The PhD in INFT accommodates rigorous and cross-disciplinary PhD study that does not fit with PhD program requirements of a single VSE department.   The PhD in INFT includes several concentrations to provide program focus.

Admissions & Policies

Admissions

Admission is competitive. An undergraduate degree in an information technology-related area, such as engineering, computer science, operations research, mathematics, or the physical sciences is typically required for admission. The undergraduate preparation should include, at a minimum, calculus, differential equations, linear algebra, discrete structures, probability, and statistics, in addition to computational proficiency, including experience with a variety of languages and computer hardware. Additional requirements depend on the proposed study focus.

Most successful applicants complete their master's degree before admission with a minimum GPA of 3.5. Applicants can also be considered directly from their undergraduate studies with a minimum GPA of 3.25.

Applicants wishing to switch fields from non-information technology-related academic backgrounds, especially those with extensive work experience in information technology, are encouraged to discuss opportunities for study. This path into the Information Technology, PhD program typically requires academic preparation in the formal framework and underpinning theory of information technology. Those applicants are referred to the VSE departments offering the concentrations and courses of greatest interest, prior to application.

Applicants are required to submit: an online application for admission, undergraduate and graduate transcripts from previous colleges and universities, GRE test results, three letters of reference (preferably from college instructors), goals statement and a résumé. Applicants are also required to submit a brief personal goals statement including the proposed research areas of interest. Admission for cross-disciplinary Information Technology, PhD study will depend on alignment with VSE faculty research expertise.

International applicants are referred to the university's English Proficiency Requirements (https://www2.gmu.edu/admissions-aid/how-apply/international/english-proficiency-requirements/). In addition, international transcripts must be translated and evaluated (course-by-course preferred) by a member of the National Association of Credential Evaluation Services (NACES). Transcripts can be evaluated by George Mason University at no extra cost to the applicant; this typically adds 6-8 weeks to the application processing time. Please review George Mason University's Policy on International Transcript Submission (https://catalog.gmu.edu/admissions/international-students/). Applications must be completed and submitted before an admission decision is made.

Policies

The general doctoral requirements (http://catalog.gmu.edu/policies/academic/graduate-policies/) of Mason apply to this program.

Degree Requirements Overview

Students must complete a minimum of 72 graduate credits. This requirement may be reduced by a maximum of 30 credits from an approved and completed master's degree. That determination requires the evaluation by, and approval of, the program director or VSE Dean or their designee, and depends on alignment of the master's degree with the proposed study focus.

Within those 72 credit hours, the program requires:

- Specialized coursework comprised of 48 credits for students with no credit for previous MS coursework. This specialized coursework requirement may be reduced to a minimum of 18 credit hours, depending on the approved credit reduction for previous graduate coursework.
- Breadth requirement, requiring completion of two Fundamental Knowledge courses, and two Qualifying Exams.
- Comprehensive exam (oral) after completion of specialized coursework.
- Development and acceptance of a research proposal plus execution of the research culminating in a public final defense. This research phase of the PhD requires 24 credit hours of:

Code	Title	Credits
Research Requirement		24
IT 990	Dissertation Topic Presentation	1
23 additional credits from the following:		
IT 998	Doctoral Dissertation Proposal	1-12
IT 999	Doctoral Dissertation (Mininimum of 12 credits required)	12

- Approval by the dissertation committee of the defense of the dissertation research in written and oral forms.

Requirements

Degree Requirements

Total credits: minimum 72

Plan of Study

Students are strongly encouraged, but are not required to select a concentration by the end of their first year. Concentration areas are based on broad areas of faculty expertise. Students who do not choose an established concentration must be flexible in their research focus, recognizing that not all faculty are available to accept doctoral students.

Concentrations
Available Concentrations
- Digital Forensics (DFOR)
- Information Sciences and Technology (ISTC)
- Information Security and Assurance (ISA)
- Information Systems (ISYS)
- Mechanical Engineering (ME)
- Software Engineering (SWE)

Specialized Coursework
Each student works with his or her faculty advisor or dissertation director to develop a plan of study. Successful coursework completion includes:

- A cumulative GPA of 3.50 in courses included on the plan of study, and all grades must be a B- or better.
- At least 12 credits on the plan of study must be courses numbered 700 or higher. No 500 level courses are permitted. The suggested courses for each concentration is as follows. Specific courses should be chosen with advisement of your faculty advisor.

Digital Forensics (DFOR)

Code	Title	Credits
AIT 701	Cyber Security: Emerging Threats and Countermeasures	
CFRS 661	Digital Media Forensics	
CFRS 663	Operations of Intrusion Detection for Forensics	
CFRS 664	Incident Response Forensics	
CFRS 730	Forensic Deep Packet Inspection	
CFRS 760	Legal and Ethical Issues in IT	
CFRS 761	Malware Reverse Engineering	
CFRS 762	Mobile Device Forensics	
CFRS 763	Registry Forensics - Windows	
CFRS 764	Mac Forensics	
CFRS 767	Penetration Testing in Computer Forensics	
CFRS 768	Digital Warfare	
CFRS 769	Anti-Forensics	
CFRS 770	Fraud and Forensics in Accounting	
CFRS 771	Digital Forensic Profiling	
CFRS 772	Forensic Artifact Extraction	
CFRS 773	Mobile Application Forensics and Analysis	
CFRS 775	Kernel Forensics and Analysis	
CFRS 780	Advanced Topics in Computer Forensics [1]	
CFRS 790	Advanced Computer Forensics [1]	
ECE 611	Advanced Computer Architecture	
ECE 645	Computer Arithmetic	
ECE 646	Applied Cryptography	
ECE 746	Advanced Applied Cryptography	
ISA 650	Security Policy	
ISA 652	Security Audit and Compliance Testing	
ISA 656	Network Security	
ISA 674	Intrusion Detection	
ISA 785	Research in Digital Forensics	
IT 796	Directed Reading and Research	

Information Sciences and Technology (ISTC)

Code	Title	Credits
AIT 602	Introduction to Research in Applied Information Technology	
AIT 614	Big Data Essentials	
AIT 624	Knowledge Mining from Big-Data	
AIT 681	Secure Software Development	
AIT 682	Network and Systems Security	
AIT 701	Cyber Security: Emerging Threats and Countermeasures	
AIT 702	Incident Handling and Penetration Testing	
AIT 711	Rapid Development of Scalable Applications	
AIT 712	Applied Biometric Technologies	
AIT 716	Human Computer Interaction	
AIT 724	Data Analytics in Social Media	
AIT 726	Natural Language Processing	
AIT 734	Advanced Web Analytics Using Semantics	
AIT 736	Applied Machine Learning	

Other VSE courses with the approval of an advisor or program director.

Information Security and Assurance (ISA)

Code	Title	Credits
ISA 673	Operating Systems Security	
ISA 674	Intrusion Detection	
ISA 681	Secure Software Design and Programming	
ISA 697	Topics in Information Security	
ISA 763	Security Protocol Analysis	
ISA 764	Security Experimentation	
ISA 796	Directed Readings in Information Security	
ISA 862	Models for Computer Security	
ISA 863	Advanced Topics in Computer Security	
CS 700	Research Methodology in Computer Science	

Any CS, INFS or SWE course numbered 700 or higher, subject to the approval of the student's academic advisor

Information Systems (ISYS)

Code	Title	Credits
At least 12 credits in INFS or ISA courses numbered 700 or higher as follows:		
INFS 623	Web Search Engines and Recommender Systems	
INFS 740	Database Programming for the World Wide Web	
INFS 760	Advanced Database Management	
INFS 770	Knowledge Management for E-Business	
INFS 772	Intelligent Agents and the Semantic Web	
INFS 774	Enterprise Architecture	

INFS 796	Directed Readings in Information Systems	
ISA 656	Network Security	
ISA 797	Advanced Topics in Information Security	

At least 6 credits from SWE and CS courses in Software Engineering and Computer Science: [1]

SWE 721	Reusable Software Architectures	
SWE 763	Software Engineering Experimentation	
SWE 796	Directed Readings in Software Engineering	
SWE 821	Software Engineering Seminar	
CS 657	Mining Massive Datasets with MapReduce	
CS 688	Machine Learning	
CS 700	Research Methodology in Computer Science	
CS 782	Advanced Machine Learning	
CS 787	Decision Guidance Systems	

[1] Students without a credit reduction should select the remaining credits from any 600 level or higher INFS, ISA, CS or SWE courses or courses approved in advance by the student's academic advisor.

Mechanical Engineering (ME)

Code	Title	Credits
600/700-level courses outside the ME department (typically physics, mathematics, etc.)		
700-level courses within the ME department in subjects within the student's area of specialization		
700-level courses within the ME department in subjects outside the student's area of specialization		
ME 620	Mechanical Engineering Decision Making	
Available courses include:		
ME 621	Foundations of Fluid Mechanics	
ME 714	Fracture Mechanics	
ME 715	Impact Dynamics	
ME 721	Advanced Fluid Mechanics	
ME 722	Introduction to Turbulence	
ME 723	Compressible Flow	
ME 724	Viscoelastic Flow	
ME 725		
ME 728	Foundations of Heat Transfer	
ME 732	Advanced Thermodynamics	
ME 740	Introduction to Continuum Mechanics	
ME 741	Theory of Elasticity	
ME 742		
ME 745	Mechanics and Properties of Materials	
ME 750	Nanomaterials Enabled Renewable Energy	
ME 751	Advanced Materials for Water Treatment	
ME 753	Tribology	
ME 754	Introduction to Nano-Materials	
ME 755	Optofluidics	
ME 762	Biosensors	

Software Engineering (SWE)

Code	Title	Credits
SWE 763	Software Engineering Experimentation	
or CS 700	Research Methodology in Computer Science	
SWE 721	Reusable Software Architectures	
SWE 737	Advanced Software Testing	
SWE 760	Software Analysis and Design of Real-Time Systems	
SWE 795	Advanced Topics in Software Engineering	
SWE 796	Directed Readings in Software Engineering	
SWE 798	Research Project	
SWE 825	Special Topics in Web-Based Software	
Select at least 6 credits from the following:		
SWE 619	Object-Oriented Software Specification and Construction	
SWE 620	Software Requirements Analysis and Specification	
SWE 621	Software Design and Architecture	
SWE 622	Distributed Software Engineering	
SWE 631	Software Design Patterns	
SWE 632	User Interface Design and Development	
SWE 637	Software Testing	
SWE 642	Software Engineering for the World Wide Web	
SWE 645	Component-Based Software Development	
SWE 681	Secure Software Design and Programming	
CS 706	Concurrent Software Systems	
INFS 740	Database Programming for the World Wide Web	
INFS 760	Advanced Database Management	
INFS 770	Knowledge Management for E-Business	
INFS 797	Advanced Topics in Information Systems	
ISA 656	Network Security	
ISA 763	Security Protocol Analysis	
ISA 764	Security Experimentation	
ISA 862	Models for Computer Security	

Breadth Requirement

To satisfy the breadth requirements of the PhD INFT, a student must demonstrate his/her proficiency in the foundational knowledge specific to her/his program of study. This is satisfied through completion of two Fundamental Knowledge courses, and two Qualifying Exams. The Fundamental Knowledge courses and the Qualifying Exams are described in the online guide maintained by the Volgenau School of Engineering Office of Graduate Academic Affairs. Selection of the two Fundamental Knowledge courses and the two Qualifying Exams must be approved by the student's PhD advisor and filed with the Volgenau School of Engineering Office of Graduate Academic Affairs.

Students must complete the breadth requirements within the following time limits. Students who enter the program with a 24-30 credit reduction from a prior Master's degree must satisfy all breadth requirements no later than twelve months following the end of their fourth semester in the program. Students who enter the program with a reduction of less

than 24 credits must satisfy all breadth requirements no later than twelve months following the end of their sixth semester in the program. In both instances, these time limits include all attempts at the Fundamental Knowledge courses and the Qualifying Exams. Time limits apply to all PhD INFT students, regardless of their part-time or full-time study status. Failure to satisfy all breadth requirements by the specified time is cause for termination from the PhD INFT program.

Fundamental Knowledge Course Requirement:

Students are required to complete two Fundamental Knowledge courses within the first 24 months of their PhD enrollment, regardless of their part-time or full-time study status and regardless of credit reductions from previous coursework. Fundamental Knowledge courses are listed in the study guide maintained by the VSE Office of Graduate Academic Affairs. Fundamental Knowledge courses must be approved by the PhD advisor; must be specific to the student's program of study; and must be submitted to the VSE Office of Graduate Academic Affairs. These courses can be used as credit toward the student's plan of study, but will not count toward his/her 700 level minimum requirement.

Students must earn a grade of A- or better in both Fundamental Knowledge courses on their first attempt to satisfy this component of the breadth requirement. Students failing to earn a grade of A- or better on their first attempt in one or both Fundamental Knowledge courses are required to take and pass in one attempt, supplementary Qualifying Exams, described below

Qualifying Exam Requirement:

Students are required to take and pass two Qualifying Exams within the time limit defined for the breadth requirement. Qualifying Exams are listed in the study guide maintained by the VSE Office of Graduate Academic Affairs. Selection of Qualifying Exams must be approved by the PhD advisor; must be specific to the student's program of study; must not duplicate the bodies of knowledge of the student's Fundamental Knowledge courses; and must be submitted to the VSE Office of Graduate Academic Affairs.

Qualifying Exams are offered twice a year, just before the fall and spring semesters. Each exam is allocated two hours and graded on a pass or fail basis. Students must take all required Qualifying Exams in their first attempt. Students failing one or both of their Qualifying Exams on the first attempt are required to retake the Qualifying Exams they did not pass the next time the Qualifying Exams are offered. Students failing Qualifying Exams may not subsequently satisfy the breadth requirement by completing Fundamental Knowledge courses.

Students failing to earn a grade of A- or better in one or both Fundamental Knowledge courses are required to take and pass supplementary Qualifying Exams in the bodies of knowledge covered by the Fundamental Knowledge courses in which they earned a grade of less than A-. Supplementary Qualifying Exams are in addition to the two required Qualifying Exams described above. Students must pass supplementary Qualifying Exams in one attempt only.

Failure to satisfy all breadth requirements, within established time limits, regardless of part-time or full-time study status, may be terminated from the PhD INFT program.

Comprehensive Exam

The comprehensive exam is an oral exam taken after students have satisfactorily completed all coursework requirements in their approved plan of study. To initiate the exam process, the student meets with his/her dissertation advisor to prepare an Oral Comprehensive Exam Request form. This Request must be approved by the entire dissertation supervisory committee and forwarded to the associate dean for final approval. The permission form must be submitted with:

- a one page description of the intended area of research; and
- a reading list on which the student will be examined.

The reading list should include articles and/or books that cover the fundamentals, state-of-the-art, and tools needed to perform research in the intended area.

The objective of the comprehensive exam is to allow the dissertation supervisory committee to assess the student's readiness to complete doctoral research in the chosen area of concentration. The duration of the oral exam is typically two hours. Students must pass the comprehensive exam and dissertation proposal defense before advancing to candidacy. The comprehensive exam must be attempted for the first time no later than one year after completing all coursework requirements and starting the IT 998 Doctoral Dissertation Proposal sequence.

Students who fail the exam are permitted to retake it once within six weeks of notification of failure of the first attempt. Failure in the second attempt will result in termination from the program.

Research Component

Research Credit Hours

Code	Title	Credits
Research Requirement		24
IT 990	Dissertation Topic Presentation	1
23 additional credits from the following:		
IT 998	Doctoral Dissertation Proposal	1-12
IT 999	Doctoral Dissertation (Mininimum of 12 credits required)	12

Once enrolled in Dissertation Research, students must maintain continuous registration in IT 998 Doctoral Dissertation Proposal until advancement and IT 999 Doctoral Dissertation until the dissertation is complete and has been successfully submitted to the library, excluding summers, unless conferring in August. For more information please see AP.6.10.6.

Faculty Advisement

On admission to the program, students are assigned a temporary faculty advisor aligned with the research area that the student identified in his/her application. The temporary faculty advisor advises on and approves the student's initial course selection.

Ultimately, all INFT PhD students require a dissertation director who will direct the student's PhD studies, including the research. This arrangement, by mutual consent, should be agreed on before the student begins their research. Topics of potential research are determined by the expertise and interests of the faculty. The student is responsible to identify, communicate and offer proof of his/her research skills to the faculty under whom (s)he wishes to work. A student's engagement, excitement, commitment and initiative are all attributes a potential dissertation director will consider before making the decision to formally commit. The university does not manage this matching process, nor does it compel any faculty member to undertake this role for a student.

Dissertation directors and their students should arrive at an understanding of the dissertation director's expectations. This must include a clear understanding of the research topic and the courses the student must complete in support of that research. It should also include, at a minimum, a timeline for the overall planned program of study, expectations regarding technical publications and presentations arising from the research, availability of graduate student support, advising style, and the location where the student will conduct the research and when. A successful dissertation depends on shared understanding.

Students have the right to change dissertation directors. Changing dissertation directors slows academic progress, and students are discouraged from changing more than once, since demonstration of satisfactory progress on the PhD is one criterion for continuation in the program. Dissertation directors also have the right to decline or to discontinue supervising students.

Doctoral Supervisory Committee

After a student and his/her dissertation director agree to work together and file this information with the VSE Office of Graduate Academic Affairs, the doctoral supervisory committee can be formed. The doctoral supervisory committee includes the dissertation director, who must be a member of the Mason graduate faculty, and at least three other people from the Mason graduate faculty. The dissertation director and chair of a PhD INFT dissertation committee must have at least a 50% appointment in the Volgenau School. This rule does not apply to a co-director. At least three committee members must be from the Volgenau School, and at least two of the departments in the Volgenau School must be represented. Representatives from industry or government with key, related expertise may also be considered as a fifth member. However, all members of the committee must hold a terminal degree.

The doctoral supervisory committee administers the comprehensive exam, the dissertation proposal presentation evaluation, and the dissertation predefense and defense. Permission for the comprehensive exam and dissertation defense are requested from the associate dean of graduate programs within the Volgenau School by submitting the appropriate committee approved forms.

Dissertation Proposal Presentation

After successful completion of the Comprehensive Exam, doctoral students prepare a written dissertation proposal to present to the doctoral supervisory committee. Students must continuously enroll in IT 998 Doctoral Dissertation Proposal to complete this effort. While in the IT 998 Doctoral Dissertation Proposal sequence, the student should enroll in IT 990 Dissertation Topic Presentation. The dissertation proposal presentation must be at least one week after passing the comprehensive exam. After successfully completing the dissertation-proposal requirement, the student is formally admitted as a candidate for the PhD degree and must begin to continuously register for IT 999 Doctoral Dissertation. The application for candidacy is submitted to the associate dean of graduate programs on a standard form.

Dissertation and Final Defense

With the concurrence of the dissertation supervisory committee and associate dean, students proceed with the doctoral research, during which time they must be continuously enrolled in IT 999 Doctoral Dissertation. When the central portions of the research have been completed to the point that students are able to describe the original contributions of the dissertation effort, they submit the written dissertation to the committee and schedule an oral predefense to the

committee. Once the committee believes the student is ready, a final public oral defense may be scheduled allowing a minimum of two weeks for the defense notification as required by the University, AP.6.10.8 (https://catalog.gmu.edu/policies/academic/graduate-policies/#text). The entire dissertation committee and the associate dean must be present at the defense, unless an exception is approved by the associate dean of graduate programs in advance of the defense.

With satisfactory evaluation of the oral defense of the dissertation by the committee, the student must submit to the library a final publishable dissertation that represents a definitive contribution to knowledge in INFT. If the candidate successfully defends the dissertation, the dissertation committee recommends that the final form of the dissertation be completed and the Volgenau School faculty and the graduate faculty of Mason accept the candidate for the PhD degree.

If the student fails to successfully defend the dissertation, the student may request a second defense, following the same procedures as for the initial defense. There is no time limit for this request other than general time limits for the doctoral degree. An additional predefense is not required, but students are strongly advised to consult with the committee before scheduling a second defense. If the student fails on the second attempt to defend the dissertation, the student will be terminated from the program.