

INFORMATION TECHNOLOGY, PHD

Banner Code: EC-PHD-INFT

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The Information Technology (INFT) PhD is a signature degree of the College of Engineering and Computing. 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 out of 4.0. Applicants can also be considered directly from their undergraduate studies with a minimum GPA of 3.25 out of 4.0.

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 College of Engineering and Computing (CEC) 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, 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 CEC faculty research expertise.

International applicants (<https://www.gmu.edu/admissions-aid/apply-now/how-apply/international/>) 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. 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, see AP.6.5 Credit by Exam, Reduction or Transfer (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-5>). That determination requires the evaluation by, and approval of, a student's faculty advisor and the College of Engineering and Computing (CEC) Associate Dean or their designee.

Within the 72 credit hours, the program requires:

- Specialized coursework comprised of 48 credits, which may be reduced. See AP.6.5 Credit by Exam, Reduction or Transfer (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-5>).
- 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.
- Execution of the research culminating in a written dissertation and public final oral defense successfully defended and approved.

Requirements

Degree Requirements

Total credits: minimum 72

Plan of Study

All INFT PhD students require a faculty advisor to guide and oversee their academic progress and research. Students are strongly encouraged to select a study 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 are still constrained by existing faculty research expertise and faculty willingness to accept new doctoral students.

Concentrations

Available Concentrations

- 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/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 except for fundamental knowledge courses. The suggested courses for each concentration is as follows. Specific courses should be chosen with advisement of the student's faculty advisor/dissertation director.

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 with Deep Learning	
AIT 734	Advanced Web Analytics Using Semantics	
AIT 736	Applied Machine Learning	

Other CEC courses with the approval of a faculty advisor/dissertation 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 faculty advisor/dissertation director.

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 faculty advisor/dissertation director.

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	Introduction to Computational Fluid Dynamics for Engineers	
ME 728	Foundations of Heat Transfer	

ME 732	Advanced Thermodynamics
ME 740	Introduction to Continuum Mechanics
ME 741	Theory of Elasticity
ME 742	Finite Element Analysis for Solids
ME 745	Mechanics and Properties of Materials
ME 750	Nanomaterials Enabled Renewable Energy
ME 751	Advanced Materials for Water Treatment
ME 753	Tribology and Surface Engineering
ME 754	Introduction to Nano-Materials
ME 755	Optofluidics
ME 762	Nano Bio Sensors
Other 600 level or higher courses with the approval of a student's faculty advisor/dissertation director.	

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	
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	
Other CEC courses with the approval of a student's faculty advisor/dissertation director.		

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 (FKC), and two Qualifying Exams (QE).

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, AP.6.10.1., (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-1>) 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 (FKC) Requirement:

Fundamental Knowledge courses are listed in the study guide maintained by the College of Engineering and Computing of Graduate Studies (CECGS). Fundamental Knowledge courses must be approved by the faculty advisor/dissertation director; must be specific to the student's program of study; and must be submitted to CECGS. These courses may be used as credit toward the student's plan of study.

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.

Qualifying Exam (QE) Requirement:

Qualifying Exams are listed in the study guide maintained by the College of Engineering and Computing Office of Graduate Studies (CECGS). Selection of Qualifying Exams must be approved by the faculty advisor/dissertation director; 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 CECGS.

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 QE's in their first attempt. Students failing one or both of their QE's on the first attempt are required to retake the QE they did not pass the next time the QE's are offered. Students failing QE's may not subsequently satisfy the breadth requirement by completing Fundamental Knowledge courses.

Comprehensive Exam

The comprehensive exam is an oral exam taken after students have satisfactorily completed all coursework requirements in their approved plan of study, passed the breadth requirement, inclusive of FKC and QE, and after the student's dissertation committee has been formed. To initiate the Comprehensive Exam process, the student meets with their dissertation director to prepare an Oral Comprehensive Exam Request form. This Request must be approved by their entire dissertation

committee and forwarded to CECGS 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 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. The comprehensive exam must be attempted for the first time no later than one year after starting the IT 998 Doctoral Dissertation Proposal sequence.

Students who fail the exam are permitted to retake it once. Failure in the second attempt will result in termination from the program.

Dissertation Proposal Presentation

After successful completion of the Comprehensive Exam, doctoral students prepare a written dissertation proposal to present to the dissertation committee. Students must 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.

Advancement to Candidacy

After successfully completing the dissertation-proposal requirement, the student is formally admitted as a candidate for the PhD degree and must begin and maintain continuous registration in IT 999 Doctoral Dissertation. The application for advancement candidacy is submitted to CECGS on a standard Registrar form.

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	1-11
IT 999	Doctoral Dissertation (Minimum of 12 credits required)	12

Once enrolled in Dissertation Research, students should maintain continuous registration in IT 998 Doctoral Dissertation Proposal until advancement to candidacy and must maintain continuous registration in IT 999 Doctoral Dissertation until the dissertation is complete, successfully defended and approved by the dissertation committee, and has been successfully submitted to the library. Continuous registration does not include summers, except for when conferral occurs in August. For more information please see AP.6.10.6 (<http://catalog.gmu.edu/policies/academic/graduate-policies/#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 their application. The temporary faculty advisor advises on and approves the student's initial course selection.

Ultimately, all INFT students require a dissertation director who will direct the student's PhD studies, including the dissertation research. This arrangement, by mutual consent of the student and dissertation director, 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 their research skills to the faculty under whom they wish to work.

A student's engagement, excitement, commitment, relevant academic and non-academic background, 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 can 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.

Dissertation Committee

After a student and their dissertation director agree to work together and file this information with the College of Engineering and Computing Office of Graduate Studies (CECGS), the dissertation committee can be formed. The dissertation 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. In addition, the dissertation director must have at least a 50% appointment in CEC. This rule does not apply to a co-director. At least three dissertation committee members must be from CEC, and at least two of the departments in CEC must be represented to meet expectations for interdisciplinary research.

Representatives from industry or government with key, related expertise may also be considered if they have been appointed to university graduate faculty status (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-5>).

The dissertation committee administers the comprehensive exam, the dissertation proposal presentation evaluation, the dissertation predefense (if applicable) and defense by submitting the appropriate forms to CECGS.

Dissertation and Final Defense

With the concurrence of the dissertation committee and CECGS, students proceed with the dissertation research, during which time they must maintain continuous registration in IT 999 Doctoral Dissertation, (AP.6.10.6 (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-6>)). Students are encouraged to draw on the expertise and guidance of their dissertation committee during their research, including submission of a draft dissertation to the committee members.

When the PhD student's research is complete to the satisfaction of the dissertation director, the student may submit the written dissertation

to the dissertation committee and engage in an oral predefense, which is encouraged, but not required. At the point when the dissertation committee believes the student has completed satisfactory research meeting their expectations for awarding a PhD, 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 (<http://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.

If the candidate successfully defends the dissertation, the dissertation committee and associate dean recommend that the final form of the dissertation be completed and the CEC faculty and the graduate faculty of Mason accept the candidate for the PhD degree. At that point, the student submits to the university library a final publishable dissertation that represents a definitive contribution to knowledge in INFT.

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 (AP.6.10.1 (<http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-1>)). Students are strongly advised to consult with their dissertation director and dissertation 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 INFT program.