DEGREE PROGRAMS

PH.D. IN COMPUTER SCIENCE PROGRAM (POST M.S.)

OVERVIEW

ADMISSION REQUIREMENTS

PROGRAM REQUIREMENTS
OVERVIEW FOR THE PH.D. IN COMPUTER SCIENCE

Overview

The doctoral program is designed for those students who have an interest in pursuing an academic or industrial research career. The student is required to make a significant contribution to the field of computer science by working on an original research problem with a committee of faculty. In addition, the doctoral student is expected to demonstrate a mastery in several areas of computer science. Each student is required to (1) pass the Ph.D. qualifying exam in order to be admitted to candidacy, (2) pass the Ph.D. comprehensive exam where the proposed research is presented. This is followed by the culminating Ph.D. thesis which results in an original research contribution and must be defended. The degree normally requires three to four years beyond the master’s degree for full-time students. Part-time students can also enter the program but will need more time to complete the degree.
ADMISSION REQUIREMENTS FOR THE PH.D. IN COMPUTER SCIENCE (POST M.S.)

- Applicants must have a M.S. degree in Computer Science. Admission is competitive and it is expected that applicants will have a high grade-point average.

- For non-English speaking applicants without a U.S. degree from an accredited institution, a minimum TOEFL score of 550 is required. If the TOEFL score is less than 600, the applicant is required, in addition, to take the English Proficiency Exam administered by the IIT Humanities Department. Graduate students with degrees from English-speaking countries are not required to submit the TOEFL score. Please check with the Graduate College for details. Note that Puerto Rican students must submit the TOEFL score.

- Applicants for Regular, degree-seeking, graduate admission must submit official GRE scores prior to admission. The GRE requirements are: at least 1100 on the verbal and quantitative part and 3.50/6.00 on the analytical part. In the old GRE system the minimum required is 1600.

- Applicants must submit three (3) letters of recommendation.

**Application Documents Required for the Direct Ph.D. in Computer Science**

Students must submit a completed application for admission plus official or certified copies of all transcripts and at least three letters of recommendation. In addition, applicants who are required to submit a TOEFL score must submit original (or certified) copies of their TOEFL results.
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PROGRAM REQUIREMENTS FOR THE PH.D. IN COMPUTER SCIENCE (POST M.S.)

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PROGRAM REQUIREMENTS FOR THE PH.D. IN COMPUTER SCIENCE (POST M.S.)

Coursework Requirements

For students entering with a MS the requirements are as follows:

1. **Students with MS in Computer Science:**
   Students with an MS in Computer Science from an approved university are required to take 18 additional credits at the 500 level. 9 of these credits are required from three separate core groups from among the six core groups. Students are required to take 9 additional 500 level credits and complete 24 credits of thesis work.

   To summarize:
   54 - 93 total credits are required, of which:
   - 1 of the PhD seminar
   - 3 - 12 of CS 597 (Reading and Special Problems)
   - 18 - 30 credits of 500 level courses apart from CS 597, with at most 6 credits from outside the CS department
   - 24 - 48 credits of CS 691 (Research/Thesis for Ph.D. Degree - after qualification)
   - 0 - 12 credits of CS 400 level courses

   3 credits of CS597 must be done in their first year. The students are also required to pass the qualifier no later than their 4th semester, with the first attempt in their 3rd semester.

2. **Students with MS not in Computer Science:**
   Students with an MS degree not in Computer Science from an approved university are required to take 5 core CS500 level courses, one each from Group 1, Group 2, and Group 3 and the remainder from at least two of the other core Groups. They are required to take 3 additional 500 Level courses and complete 24 credits of thesis work.

   To summarize:
   60 - 99 total credits, of which:
   - 1 of the PhD seminar
   - 3 - 12 CS 597 (Reading and Special Problems)
   - 24 - 30 credits of 500 level courses, with at most 6 credits outside the CS department
   - 24 - 48 credits of CS 691 (Research/Thesis for Ph.D. Degree - after the qualification)
   - 0 - 12 credits of CS 400 level courses

   3 credits of CS597 must be done in their first year. The students are also required to pass the qualifier no later than their 4th semester, with the first attempt in their 3rd semester.

3. **Students transferring into the PhD program from another program.**
   The transfer of courses will be decided by the graduate committee on a case-by-case basis.

Core Courses

The groups are:

Group I: Theory of Computation
- CS 530 - Theory of Computation
- CS 533 - Computational Geometry
- CS 535 - Analysis of Algorithms
- CS 538 - Combinatorial Optimization

2. Group II: Systems
3. Group III: Programming Languages
   - CS 536 - Science of Programming
   - CS 541 - Topics in Compiler Construction
   - CS 545 - Distributed Computing Landscape

4. Group IV: Networks
   - CS 542 - Computer Networks I: Fundamentals
   - CS 544 - Computer Networks II: Network Services

5. Group V: Databases
   - CS 525 - Advanced Database Organization

6. Group VI: Software Engineering
   - CS 586 - Software System Architectures

PH.D. QUALIFIERS
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Ph.D. Qualifying Examination

To ensure that the students are well prepared for research in their chosen area, a Ph.D qualification is required. The Ph.D. qualification is to be based on an exam. The exam will have two parts, the oral and the written, both of which have to be cleared by the student.

Time Schedule

For direct PhD students, the first attempt in oral examination and the written examination must be taken no later than a student's 5th semester. The second attempt must be taken no later than a student's 6th semester. These requirements hold for both full-time and part-time students.

For post-MS PhD students, the first attempt in oral examination and the written examination must be taken no later than a student's 3rd semester. The second attempt must be taken no later than a student's 4th semester. Part-time students should take this exam no later than the semester in which they complete 24 credit hours in the Ph.D. program, with a second attempt (if necessary) the following (not counting Summer) semester.

Students admitted up to Fall 2003 who chose to complete the "old program", the same requirements apply with the exception that the three written examinations are not required.

Repeating the Exam:

Every student must pass these exams with at most two attempts. A student has to repeat only the areas in which he has failed.

Oral Qualifier

Purpose of the Oral Qualifier:

The purpose of the qualifier is to judge the research capabilities of the student. It is to be determined if the student is capable of the academic elements that constitute the research process. These elements may be categorized as:

- a scholarly review of the topic,
- a formal description of the problem,
- familiarity with techniques that may be useful in solving the problem
- innovative ideas useful to solving the problem,
- finally, the student should show a capability to present his work in written as well as oral form.

It is expected that the student will address the above requirement by presenting one or more research problems, carefully reviewed, exhibit knowledge of techniques required to solve the problem, propose partial or full solutions and show prospects for further research, if possible.

While the student may address more than one problem, the student should guard against simply reviewing a number of problems as evidence of his research capabilities. It is possible that the student has published, based on his research. This is additional evidence of his capabilities.

Procedural Issues:

The following rules apply from SPRING 2004:

- The PhD coordinator will co-ordinate the exam.
The student will be examined by a faculty group, which excludes the advisor. Each group will decide the format of the exam. This could be:

- A description of research of the student's choice.
- Specific paper/topic assignment to the student.

- A written report may be required. The examination methodology should be announced to the student well in advance.

- The qualifier date is to be held at the beginning of the semester. The date, time and schedule would be announced at least two weeks in advance.

- The exam will be closed. A review of the examination will be intimated to the student along with the result of the exam within a week of the exam.

- Each student would either:
  - Pass
  - Fail
  - Conditional Pass. The exact nature of the condition is to be decided by the Committee. The student could be required to do a course or some other assigned task.

- The results of the written exams will be available within ten days of the exam. After that, a student who failed a subject has ten days to request a re-examination of his/her exam. The request must be in writing and explain why the student believes the score of the exam is not correct, and be sent to the PhD coordinator. The graduate committee would answer the request for re-examination within ten days.

**The Written Examination Areas**

Three areas will be tested:

1. Theory (algorithms, complexity, computability, formal languages)
   Topics come from CS 532 (CS 530 and an undergraduate course in formal languages is a valid substitute) and from CS 535.

   The exam is closed notes and will last 2.5h. Three problems will be given. Relevant chapters form the two reference books below will be provided together with writing paper. No other help (notes, calculators, cell phones, etc.) is allowed, except for writing pens. The problems will relate to material from the book chapters listed below.

   From "Introduction to Algorithms", second edition, by Cormen, Leiserson, Rivest, and Stein, the following chapters:

   2, 3, 4 without 4.4, 6, 7, 8, 9, 10, 11 without 11.5, 12 without 12.4, 13, 14, 15, 16 without 16.4, 16.5, 17, 19, 20, 21 without 21.4, 22, 23, 24, 25, 26 without 26.4, 26.5, 34

   From "Introduction to the Theory of Computation", by Sipser, the following chapters:

   1, 2, 3, 4, 5, 7

   In Fall 2004, the exam consisted of Problem 2-20 from Sipser and problems 9-2 and 22-3 from Cormen et al.

   The exam given in Spring 2005 is available in PDF [here](#). The difficulty level is comparable to final exams from CS 532 or CS 535.

**Reference books:**

- CS 530
- CS 535

2. Operating systems

   Topics come from CS 450 and CS 550.

**Reference books:**

- CS 450 and CS 550
  - Silberschatz, Galvin, and Gagne. *Operating system concepts* Sixth edition, Wiley

**Topics:**
CS 550
- Issues in communication including Remote Procedure Call, Remote Method Invocation, and Message- and Stream-Oriented communication
- Processes and threads
- Naming
- Synchronization
- Consistency and replication
- Fault tolerance
- Distributed file systems
- Security in distributed systems

The exam will be closed books and closed notes, with a time limit of two hours. The exam given in Spring 2005 is available in PDF here. No other exams are available.

3. Programming languages
Topics come from CS 536 (and its CS 440 as prerequisite material).

Reference books:
- **CS 440**
- **CS 536**

Topics:
- **CS 440**
  - Language design
  - Compilation and Interpretation
  - Programming language syntax
  - Names, scopes and bindings
  - Parameter passing scheme
  - Semantic analysis
  - Control flow
  - Recursion
  - Data types/Data abstractions
- **CS 536**
  - Deductive proofs
  - Predicates
  - Using assertions to document programs
  - Predicate transformer: WP
  - Deterministic/non-deterministic semantics and proof rules
    - skip, abort, and composition commands
    - assignment commands
    - alternative commands
    - iterative commands
  - Topics in formal methods
    - A Hoare Logic for Shared-Variable Concurrency
    - A Hoare Logic for Synchronous Message Passing
    - Transformational Design and Hoare Logic
    - Parallel Program Design
      - Parallelism and Programming
      - Programming Notation
      - Programming Logic
      - Architectures and Mappings
    - Proof techniques for shared variable programming
    - Proof techniques for distributed programming
The exam will be closed books and closed notes, with a time limit of two hours. The exam given in Fall 2004 is available in PDF [here](#). The exam given in Spring 2005 is available in PDF [here](#).
Program Requirements for the Ph.D. in Computer Science (Post M.S.)

Comprehensive (Research Proposal) Examination

The purpose of the Comprehensive Examination is to ensure that the candidate has the background to carry out successful research in the chosen area and that the research problem is properly formulated and has sufficient scholarly merit. The student (in concert with the student's research advisor) must develop and orally present a research proposal containing a literature review, a proposed research topic, and a program of research based upon this topic. The research proposal must be written.

The student must request appointment of an examination committee. The examination committee may consist of from four to seven members. It must include at least three full-time faculty members from the Computer Science Department and one full-time faculty member from another department in the University. Other committee members from inside or outside the University may be chosen. The student should consult with his/her research advisor concerning the makeup of the committee.
Thesis Defense

Each student must present an oral defense of his/her Ph.D. Thesis. The Thesis Review Committee is appointed in much the same way as the Ph.D. Comprehensive Examination committee. It will examine the written thesis and examine the student during the oral defense. All Ph.D. Thesis Defenses are open to the public.
Establishing a Program of Study

Every student in the Ph.D. Program must file a Program of Study (Form #401). Full-time students must file the Program of Study (Form #401) within four months after enrollment. Part-time students must file the Program of Study before completing 12 credit hours in the Ph.D. program at IIT.

The Program of Study is prepared after consultation with the advisor and lists all of the courses that a student plans to take as part of the Ph.D. Program (including courses that have been completed). This form must be signed by the advisor and the Department Chair (or an Associate Chair).

Modifying a Program of Study

A Program of Study may be modified through the submission of Form #406. Form #406 must be signed by the advisor and the Department Chair (or an Associate Chair). Changes in the program may or may not be approved by the graduate dean after the student has filled an application for graduation.
Residence Requirements

University regulations require that each Ph.D. student must spend a minimum of two regular semesters in full-time study on campus. In special cases, two summers of research or other day-time graduate activity may be substituted for one of the two semesters. A full-time student is one who registered for at least 9 credit hours in a regular semester or six credit hours in the summer.
PROGRAM REQUIREMENTS FOR THE PH.D. IN COMPUTER SCIENCE (POST M.S.)

Applying for Graduation

Each student who expects to receive a graduate degree in a given semester must file an application for graduation in the Graduate College within 2 weeks of the start of the intended semester of graduation. No application will be accepted after that date and no changes in a Program of Study are allowed after that date. An application for graduation is good for only one semester. If the student fails to graduate in the intended semester, a new application must be filled for a later semester (No additional fees will be charged for filling a second application).

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Time Limit

Every student is given up to six calendar years to complete the Ph.D. Program. This time interval begins when the Ph.D. Program of Study (Form #401) is filed. Should this time limit expire, the student will be required to petition the Dean of the Graduate School to have the time limit extended. Such an extension will ordinarily entail additional examinations and fees.