Engineering, Doctor of Philosophy (Ph.D.) with a concentration in computer science/Computer Science Ph.D. with the University of Cordoba [dual degree]

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ENGINEERING, DOCTOR OF PHILOSOPHY (PH.D.) WITH A CONCENTRATION IN COMPUTER SCIENCE/COMPUTER SCIENCE PH.D. WITH THE UNIVERSITY OF CORDOBA [DUAL DEGREE]

Program mission

The mission of the Ph.D. in Engineering degree program is to provide graduate students with learning opportunities for acquiring a broad foundation of engineering knowledge, an in-depth original research experience at the frontiers of engineering, and skills for lifelong learning and professional development. Graduates of this program will pursue careers in research and development or academia.

Program goals

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. Demonstrate abilities in research: Graduates will demonstrate the ability to identify pertinent research problems, to formulate and execute a research plan, to generate and analyze research results, and to communicate those results through oral presentations and written publications. Graduates will be able to creatively solve the research problems posed.

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. (http://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. (http://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. (http://bulletin.vcu.edu/academic-regs/grad/graduation-info)

Other information

Student handbook (http://www.egr.vcu.edu/current-students/graduate-student-services/resources-forms) is available on the College of Engineering website.

Apply online at graduate.admissions.vcu.edu (http://graduate.admissions.vcu.edu)**.**

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
Ph.D.	Fall	Jun 1 (Jan 15 for financial assistance)	GRE-General
	Spring	Nov 15	TOEFL required for international students

All applicants to the dual-degree Ph.D. program with VCU and the University of Córdoba must meet all general admission requirements of the VCU Graduate School (http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements) and the College of Engineering. Applicants to the dual-degree Ph.D. program are selected from among the students already enrolled in either VCU's Ph.D. in Engineering computer science concentration or in the University of Cordoba's Ph.D. in Computer Science. The selection will be performed by the dual-degree Ph.D. program steering committee consisting of the chair and graduate program director of computer science at VCU and the chair and graduate program director of computer science at UCO.

Students need to apply to the dual-degree program after already being enrolled in the doctoral program at either VCU or UCO and before passing the oral comprehensive examination. Students must have identified a dissertation adviser (and a co-adviser from the other institution).

To be admitted to the dual-degree program, VCU students must hold an M.S. degree in computer science with a minimum GPA of 3.0. To be admitted to the UCO Ph.D. program and into the dual-degree program, UCO students must fulfill the following requirements with regard to academic qualifications:

1. Applicants with degrees in engineering or architecture or any degree with 240 ECTS credits must have completed a research master's degree, including at least 16 ECTS credits for training in methodology and research, as well as a research dissertation.
2. Applicants with degrees in engineering or architecture or any degree with 240 ECTS credits who have completed a non-research master's degree (i.e. professional master's degree) must have completed additional training at the doctoral level in methodology and research equivalent to16 ECTS credits, as well as a research project equivalent to 16 ECTS credits.
3. Graduates who have completed degrees, in accordance with EU law, worth a minimum of 300 ECTS credits, must have completed additional training at the doctoral level in methodology and research equivalent to 16 ECTS credits, as well as a research project equivalent to16 ECTS credits.
4. Applicants with university qualifications who, prior to obtaining a place on a specialized health training course, have successfully completed at least two years of training as part of a program leading to an official qualification in any health sciences specialty, may be admitted directly or may be required to complete additional doctoral training as established by the academic committee for the doctoral program.
5. Applicants already holding doctorates under earlier university regulations or holding diplomas in advanced studies in accordance with the provisions of Royal Decree 778/1998 of 30 April, or who have demonstrated sufficient research ability in terms of Royal Decree 185/1985 of 23 January, may be admitted directly or may be required to complete additional doctoral training as established by the academic committee for the doctoral program.
6. Applicants holding master's degrees awarded in accordance with foreign education systems may be admitted to doctoral study without needing to have their degrees officially recognized, once the University of Córdoba has established that their degrees demonstrate a level of training equivalent to that provided by Spanish master's degrees, including the research training required under the present regulations, and entitles the holder to be admitted to doctoral studies in the country of issue. Admission does not, under any circumstances, imply official recognition of any previous degree held by the applicant, nor recognition for any purposes other than that of admission to doctoral study.
7. VCU students must complete all VCU Ph.D. degree requirements before the Ph.D. degree from the University of Cordoba may be awarded.

Degree requirements

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

A minimum of 30 graduate credit hours beyond the M.S. degree, including research credit, is required at VCU for the Ph.D. in Engineering with a concentration in computer science. Students must complete a minimum of 12 graduate credits hours (i.e., four courses) of didactic course work and 18 graduate credit hours of dissertation research. At least half of the 12 didactic credits required must be at the 600 level or above. No elective courses may be used for both M.S. and Ph.D. degrees. The student adviser must approve all course work.

A minimum of three years of study, including research, is necessary to complete all requirements for the Ph.D. A period of residence of at least three consecutive semesters is required. Residency is defined as registration for at least nine credits per semester. A time limit of eight calendar years, beginning at the time of first registration, is placed on work to be credited toward the Ph.D.

Students admitted into the Ph.D. program with a B.S. degree should refer to the program page for information on the Ph.D. in Engineering with a concentration in computer science (http://bulletin.vcu.edu/graduate/school-engineering/engineering-phd-concentration-computer-science).

Didactic course work

VCU and UCO students in the dual-degree Ph.D. program will take four graduate courses: three from VCU (offered by VCU computer science faculty) and one from UCO (offered by UCO computer science faculty) as determined by the steering committee. The VCU courses include all approved graduate-level courses available to VCU computer science doctoral students. The following course is currently offered by UCO. The list of UCO courses will be updated every year by the steering committee.

54-22092014 Evolutionary Algorithms in Data Mining, 3 credit hour

The objective of this course is to introduce students to the field of evolutionary computation, as well as its applications to data mining problems. Genetic algorithms and genetic programming as well as evolutionary programming and evolutionary strategies will be covered. The second part of the course will focus on solving relevant problems in the field of data mining such as classification, regression, clustering,

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association rule mining, subgroup discovery and feature selection with EC approaches. Prerequisites: graduate standing. The course will be offered as an online course.

Foundation areas for computer science graduate studies include theory, systems and applied computer science. By the time of graduation, students must have completed at least one course from each of the following two foundation areas of theory and systems.

VCU faculty will deliver the courses for both VCU and UCO students (to the latter by synchronous broadcasting used currently for delivering M.S. programs to the Naval Surface Warfare Center at Dahlgren, while UCO will deliver its courses (one or more) to UCO and VCU students as asynchronous online course(s).

The courses will have identical names and will be cross-listed in the VCU and UCO bulletins and will be open to all VCU and UCO computer science students as long as there is at least one student from the dual-degree Ph.D. program enrolled in the course.

Students will register for the four required graduate courses at their universities and will pay their university tuition and fees, in spite of the fact that some will be delivered by the other university.

Dissertation committee

The dual-degree Ph.D. program dissertation committee will consist of the main adviser (from one university) and one co-adviser (from the other university) plus six members, three from VCU and three from UCO, for a total of eight members. The committee will be formed during the semester in which the student is admitted to the dual-degree program.

Admission to candidacy

Before admission to doctoral candidacy, students must have: (1) completed required course work, (2) successfully passed both written and oral comprehensive examinations and (3) fulfilled all additional departmental requirements.

Qualifying comprehensive examination

1. The qualifying comprehensive exam focuses on the subject matter deemed critical as a foundation in the program and is largely based on material covered in courses and its application to theoretical and practical problems

2. The qualifying comprehensive examination will cover knowledge in three areas and, in order to pass, students must score a minimum of 75 percent in each area.
    a. The exam must include material based on CMSC 501 from the theory area and on at least one course from the systems area.
    b. The third is the area of specialization based on courses to be decided by the dissertation adviser.

3. Students are allowed to take the exam based on courses they may not have taken, however, they still have to satisfy the course requirements as mentioned above.

4. Students may contact the lead professor for any area and obtain a list of topics that will be covered in the exam.

5. The exam will be conducted a minimum of once a year and will be organized by the VCU graduate program director, with prior approval of the exam questions by the graduate committee. The exam will be organized at the same date and time for VCU and UCO students. Students will be taking the exam in their home universities.

6. Students who fail the qualifying comprehensive exam are allowed one additional attempt to pass it. Students who fail one area of the

required three qualifying comprehensive exam areas must retake the exam in the failed area within the following year. The department may organize and schedule, no earlier than 60 days after the failed exam, a special comprehensive exam for such students. Students who fail two or more exam areas must retake the entire qualifying comprehensive exam at the regularly scheduled comprehensive exam within the following year.

7. Graduate students may not take the comprehensive exam if their overall GPA is less than 3.0. They also must have a minimum GPA of 3.0 on the courses covering the exam areas.

Oral comprehensive examination

The oral comprehensive exam requires students to prepare a written proposal of original research and to defend it in front of the dissertation committee. The oral comprehensive exam may be taken only after successful completion of the qualifying comprehensive exam.

Dissertation research and defense

During their studies, students must complete 18 credit hours of research at their own institutions. The student must conduct a substantial original investigation under the supervision of the advisers and prepare a dissertation reporting the results of this research and analyzing its significance in relation to existing scientific knowledge.

When the dissertation has been completed, copies in accepted form and style are submitted to the members of the advisory committee. The committee members decide upon the acceptability of the candidate's dissertation. A favorable unanimous vote is required to approve the dissertation, and all examiners are required to vote.

If the advisory committee accepts the dissertation for defense, the candidate appears before them for a final oral examination. This examination is open to all members of the faculty. The final oral examination will be limited to the subject of the candidate's dissertation and related matters. A favorable vote of the candidate's advisory committee and no more than one negative vote shall be required for passing the final oral examination. All committee members must vote. There shall be an announcement of the candidate's name, department and title of dissertation, together with the day, place and hour of the final oral examination at least 10 working days in advance. The UCO doctoral committee must approve/disapprove the defended dissertation.

International experience

Students, after passing comprehensive exams, will spend six months conducting research at the co-adviser's university. While abroad, the students must maintain full-time student status (to keep benefits such as a stipend) at their home institutions by registering for dissertation research credit hours. They will also need to register for one graduate credit hour at the co-adviser's university. (The UCO student would register for one VCU graduate credit hour while at VCU, and a VCU student for one UCO graduate credit hour while at UCO.) The hosting department is responsible for covering the cost of the one graduate credit-hour registration of the visiting student, in order for the student to qualify for health insurance.

Publication requirement

Students must publish at least one journal paper before the final defense takes place. Since the Ph.D. is awarded for completion of work on an original research problem, peer-reviewed evidence of the quality of this work, in terms of at least one journal paper (in a student's research area), must be approved by the dual-degree program dissertation committee

and the graduate committee before the final dissertation defense may be scheduled. Specific publication requirements are available on the Department of Computer Science website as well as in the College of Engineering graduate handbook.

Curriculum requirements

Course	Title	Hours
VCU didactic course work		
Select nine credits from the three areas.		
Foundational area: theory		
Select at least one of the following:		3
CMSC 501	Advanced Algorithms (required)	
CMSC 526	Theory of Programming Languages	
CMSC 620/ CISS 624	Applied Cryptography	
CMSC 621	Theory of Computation	
Foundational area: systems		
Select at least one of the following:		3
CMSC 502	Parallel Algorithms	
CMSC 506/ EGRE 526	Computer Networks and Communications	
CMSC 608	Advanced Database	
CMSC/CISS 618	Database and Application Security	
CMSC 622	Network and Operating Systems Security	
Specialization area		
With dissertation adviser, select an additional three credit hours of CMSC course work or other engineering or science courses in MATH/OPER/STAT/EGRE		3
UCO didactic course work		
Select at least one course from the list of UCO offerings (updated each year by steering committee)		3
Directed research		
CMSC 697	Directed Research	18
Total Hours		30

Total graduate credit hours required (minimum) 30
Typical plan of study

Students must apply to the dual program after being enrolled at either the VCU or UCO doctoral program and before passing the oral comprehensive examination, and must have a dissertation adviser (and a co-adviser from the other institution). The oral comprehensive exam should be completed by the end of the third year. Students must pass the qualifying comprehensive exam before taking the oral comprehensive exam. The plan of study is developed with the student adviser and co-adviser, taking into consideration the student's area of research.

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