# INFORMATION TECHNOLOGY, PHD

**College of Information, Science & Technology**

## Vision Statement

The PhD program is to prepare students with the following abilities:

- Strong understanding of the theory and application of information technology focused around the core areas of computer science, management information systems and interdisciplinary informatics.
- Knowledge of the analysis, design, development, and implementation of current and future information technologies;
- Excellence in conducting and managing high-quality, basic and applied research;
- Solid grounding in the fundamentals of academic teaching;
- Strong foundation in multidisciplinary and emergent areas in information technology

## Program Contact Information

Sajda Qureshi, PhD, Graduate Program Chair (GPC)
173E Peter Kiewit Institute (PKI)
402.554.2837
squreshi@unomaha.edu

Ms. Leslie Planos, Advisor
176C Peter Kiewit Institute (PKI)
402.554.3819
lplanos@unomaha.edu

Ms. Vanessa Hatfield-Reeker, Advisor
175C Peter Kiewit Institute (PKI)
402.554.3819
vhatfield@unomaha.edu

## Program Website (http://phd.ist.unomaha.edu)

# Admissions

## Application Deadlines

- Fall: February 15
- Spring: September 15

## Program-Specific Requirements

- Applicants are required to have a command of oral and written English. Those who do not hold a baccalaureate or other advanced degree from the U.S., **OR** a baccalaureate or other advanced degree from a pre-determined country on the waiver list, must meet the minimum language proficiency score requirement in order to be considered for admission.
  - For applicants that are required to take the TOEFL: must score at least 577 paper-based; 90 iBT, 7 IELTS, or 61 PTE.
- Proficiency in English communication both written and verbal. The ability to read, comprehend and write academic papers is a key criterion in assessing proficiency in English communication.
- Graduate Record Examination (GRE): GRE scores must be submitted but are only one component of a holistic admission decision. Successful applicants have typically had GRE scores of 150 verbal and 160 quantitative or better.
- Demonstrated superior performance in mathematics, including calculus, discrete mathematics and statistics, or a sequence of courses in the theory and practice of one or more areas of computer science, information systems, or a closely related field.
- Publications in scholarly journals and/or conferences, graduate theses and/or research projects. These offer documentation of interest and commitment to scholarly activities and research.
- Three (3) Letters of Recommendation
  - From references who are able to give an in-depth evaluation of your strengths and weaknesses with respect to academic work, and who are competent to judge your probability of success in graduate school.
- Statement of Purpose is required (not to exceed two pages) which address the following questions:
  - What do you hope to accomplish with a PhD in Information Technology? Please describe briefly the area of Information Technology you would like to contribute to.
  - Why are you applying to this specific program? Please offer specific details as to why you feel you are a good fit for this program.
  - What background or qualifications do you have that you believe are essential to success in this program? Please provide specific academic accomplishments as evidence of your ability to conduct research.
  - What general area or topics do you hope to study? Please offer names of IS&T Faculty with whom you would like to work and/or Labs in which you would like to conduct your proposed research.
  - What do you expect to be doing five to ten years after finishing the PhD program?
- Writing Sample
  - Evidence of graduate potential in the form of academic papers, publications, theses or project reports done in an academic or industrial setting. Group project reports do not constitute evidence of an applicant's writing ability.
- Resume

Students with an undergraduate or graduate degree in computer science, management information systems, bioinformatics, cybersecurity or a closely related discipline can apply for admission to the PhD program. Admission decisions are based on the review of application material by the College of IS&T's Doctoral Program Committee (DPC).

In addition to an applicant's past academic record and scholarly potential mentioned above, the DPC will consider the match between the applicant's research interests and ongoing research by the IS&T graduate faculty while making admission decisions.

The committee will no longer offer "conditional" admission option for international graduate students. To be officially admitted into the Graduate College, an international applicant must have a qualifying English Language Proficiency score (TOEFL, IELTS, etc.) on file with the Office of Graduate Studies. Applicants who do not have a qualifying English language proficiency score must fulfill the English proficiency requirement prior to being admitted to a graduate program.

### Admission Decision Timeline

Candidates who meet the minimum requirements may be invited by the committee to phone interviews. These are usually conducted within 4-8 weeks following the application deadline. Admission decisions are usually made within 2-3 weeks following the phone interview.

# Degree Requirements

The PhD in IT program requires 90 credit hours of graduate-level studies. Undergraduate course credits taken at UNO or another institution cannot be counted toward the PhD degree in IT. Dual-listed undergraduate courses ending in 8**5 cannot be counted as course credits in the PhD program. Only three courses ending in 8xx6 are allowed in the 45 hours of doctoral-only coursework.

The coursework taken by a student is entered into a plan of study that must be approved by the doctoral program committee before the beginning of the PhD student's second year of studies. The coursework consists of foundation courses, doctoral seminar and colloquia, a major field of study, and the dissertation. The different categories of credit-hour requirements for the program are outlined below.

### Foundation Courses 24 credit hours

Foundation courses constitute any of the courses offered in the Master's Degree in IT-related field (e.g.: computer science, management information systems, cybersecurity, IT innovation). In order to complete the breadth requirement, students must successfully complete a course in an area that is not their major field of study.

### Core Courses 12 credit hours

| Code | Title | Credits |
|---|---|---|
| CIST 9080 | RESEARCH DIRECTIONS IN IT | 3 |
| CIST 9040 | COLLOQUIUM ON I.T. RESEARCH | 1 |
| CIST 9050 | COLLOQUIUM ON I.T. TEACHING | 1 |
| CIST 9060 | COLLOQUIUM ON I.T. PROFESSION AND ETHICS | 1 |
| ISQA 9150 | RESEARCH IN INFORMATION TECHNOLOGY | 3 |
| or a Doctoral Program Committee approved graduate research course) | | |
| A doctoral level statistics course approved by the Doctoral Program Committee | | 3 |
| Total Credits | | 12 |

### Major Field of Study 18 credit hours

Coursework in the major field of study provides students the advanced study needed to develop an in-depth knowledge of their chosen field of research. For students who have indicated a concentration within their PhD in IT plan of study, this comprises the concentration credit hours. At least 3 courses (9 hours) must be in 9000-level courses. The remaining courses should include at least one 8000-level graduate-only course.

### Electives 12 credit hours

Selected in consultation with your advisor.

### Dissertation 24 credit hours

The coursework taken by a student is entered into a plan of study that must be approved by the doctoral program committee before the beginning of the PhD student's second year of studies. Undergraduate courses, either taken at UNO or at other universities, are NOT allowed to be counted as credits toward the PhD degree.

### Total 90 credit hours

## Comprehensive Examination & Admission to Candidacy

Comprehensive exams will typically be scheduled around the middle of the Fall and Spring Semester, as needed. The student intending to take the exam should inform the Doctoral Program Committee (DPC) chair about the intent to appear in the examination in writing preferably over email at least one semester before the semester during which they plan to take the exam. The comprehensive exam is a research readiness examination – that means that students should take it only when they are confident that they have a mature understanding of research, both broadly and in the specifics of their major field of study.

The comprehensive examination is taken after the student has completed all coursework according to his or her plan of study and formed a supervisory committee. Comprehensive exams consist of three parts: Part 1 of the comprehensive exam is set by the DPC which comprises faculty who are not on the candidate's supervisory committee. Part 2 of the comprehensive exam is set by the candidate's supervisory committee. Part 3 is the dissertation proposal defense. The comprehensive exam consists of a written part (1 and 2) and an oral part (3). The written part of the exam is divided into two sub-parts that will be scheduled over two consecutive days in the following order.

- Written Part I Examination Format and Procedure: The DPC is responsible for examining the candidate's knowledge and ability to conduct academic research in the Breadth area. Before taking the written part of the exam, students will provide a selection of 4-5 topics from the areas covered in the CIST 9080 course. The selected topics should not have significant overlap within the major or minor area of study given in the student's plan of study. The topics should be selected so that they express a breadth in the areas in the core disciplines of the program in computer science, information systems and integrated informatics. The DPC will select two topics from the set of 4-5 topics and inform the student in advance of the exam. The material related to the topic for preparing for the comprehensive exam (e.g., paper reading list) will already have been provided to the student when the student took the CIST 9080 course. Questions on the selected topics will be set by the faculty presenter(s) of the topic in CIST 9080. The answers will also be evaluated by the topic's presenter(s), either individually or by a group of faculty members selected by the topic's presenter(s).
- Written Part II Examination Format and Procedure: Depth exam is set and graded by the candidate's supervisory committee. The questions for the second part of the written comprehensive exam evaluate the student's understanding of his or her major field of study.

Once the student has successfully passed both written portions of the comprehensive exam, they may proceed to the oral exam.

- Oral Examination Procedure: The oral component of the comprehensive exam is the defense of the student's dissertation proposal. The oral portion cannot be taken without successfully passing both written parts of the exam.

The faculty grading the candidates' exams will be responsible for communicating the pass/fail grade to the DPC. A PhD student advances to candidacy after successfully passing all parts of the comprehensive examination. Should the student fail the comprehensive examination or a part thereof, he/she may be allowed to re-take it during the following academic term upon specific recommendation by the DPC. Students may appeal their comprehensive exam grade if they believe that their grade was assigned in an arbitrary or capricious manner.

The outcome of taking a comprehensive exam is Pass or Fail. There is no option to revise a comprehensive exam, especially one that has received a Fail grade. If a student fails any part of their comprehensive exam, they have the option to retake the entire exam upon the permission of the DPC.

For Grade Appeals, students may refer to the Graduate College Grade Appeals policy https://www.unomaha.edu/graduate-studies/current-students/quality-standards.php#k

## Dissertation

### Dissertation Credits

The dissertation of a PhD candidate is supervised by the chair or co-chairs of the student's supervisory committee in consultation with other members of the supervisory committee. While doing his or her dissertation, the candidate should take hours for the course CIST 9990. A minimum of 24 hours of this course is required for graduation. Dissertation course credits should be taken only after the PhD student advances to candidacy. PhD students may take dissertation credits during the semester they apply for candidacy if they have completed all their other courses, but the dissertation credits taken under these circumstances should be kept to a minimum. Dissertation credits cannot be taken if the student does not pass the written part of the comprehensive exam.

IMPORTANT NOTE: A minimum of seven months must elapse between the date of the PhD student's advancement to candidacy and the date of his or her dissertation defense.

### Scheduling Dissertation Defense

When the supervisory committee deems it appropriate for the PhD candidate to defend his or her dissertation, the PhD candidate should prepare a dissertation and submit it to the supervisory committee members. While submitting the dissertation to the supervisory committee, the candidate should also submit a final oral exam form to the Office of Graduate Studies. The final oral exam form requires the signatures of the supervisory committee members and the doctoral program committee chair, and should be submitted at least four weeks before the desired date of the dissertation defense. Supervisory committee members should sign this form after receiving the final draft of the dissertation.

IMPORTANT NOTE: Before scheduling his or her dissertation defense, the student should refer to the Office of Graduate Studies website and/or the current Graduate Catalog for the graduation checklist, dissertation filing deadlines and commencement dates for the semester in which he or she plans to graduate. Be sure to apply to graduate in MavLINK prior to the deadline.

### Exit Requirements

- Completing Graduation Requirements
- After successfully defending his or her dissertation, the student should complete a Report on Completion of Degree Form.

## Teaching Requirements

- All PhD students are required to teach at least ONE course while studying in the program.
- The DPC recommends that students teach in their area of interest. It is recommended that doctoral students teach at least a course while studying in the program.
- Students who are assigned to teach a course will be designated as the instructor for a section of the course to which they are deemed qualified to teach. They will be trained and evaluated by a mentor prior to and while teaching the course.

### Timing of Teaching Activities

Teaching a course is an intense activity and can usually consume considerable time and effort. To avoid interference with his or her research work, a student should plan to teach a course, especially if teaching it for the first time, toward the beginning or mid-point of their PhD studies. Students should plan to teach a course usually in the second or third year of studies.

## Residency Requirements

All full-time doctoral students must complete 27 hours within a consecutive18 month period in order to meet the residency requirement of the university. Part-time students must complete 24 hours within a consecutive 24 month period. The residency requirement ensures that progress toward the degree occurs within a reasonably compact time frame, enabling the doctoral student to integrate his or her course work with the dissertation.

## Human-Centered Computing

| Code | Title | Credits |
|---|---|---|
| ISQA 9030 | BEHAVIORAL AND ORGANIZATIONAL ISSUES IN INFORMATION SYSTEMS | 3 |
| ISQA 9900 | SEMINAR IN COMMUNICATION & TECHNOLOGY | 3 |
| CSCI 8256 | HUMAN COMPUTER INTERACTION | 3 |
| CIST Research Seminar | | 3 |
| **Electives** | | 9 |
| ISQA 8510 | MANAGING USABILITY FUNCTIONS IN SYSTEMS DEVELOPMENT ORGANIZATION | |
| BIOI 8850 | SPECIAL TOPICS IN BIOINFORMATICS | |
| CSCI 8266 | USER EXPERIENCE DESIGN | |
| CMST 8196 | COMPUTER-MEDIATED COMMUNICATION | |
| ISQA 9010 | FOUNDATIONS OF INFORMATION SYSTEMS RESEARCH | |
| SOC 8060 | QUALITATIVE METHODS | |
| COMM 9400 | SEMINAR IN COMMUNICATION & TECHNOLOGY | |
| Other courses can be considered with advisor approval. | | |
| Total Credits | | 21 |

## Academic Performance

### Residency Requirements

All full-time doctoral students must complete 27 hours within a consecutive18 month period in order to meet the residency requirement of the University. Part-time students must complete 24 hours within a consecutive 24 month period. The residency requirement ensures that progress toward the degree occurs within a reasonably compact time frame, enabling the doctoral student to integrate his or her course work with the dissertation.

### Progress Report

At the end of each semester, every doctoral student (full-time or part-time) must complete the Progress Report form and submit it to the Director of the Doctoral Committee. An electronic copy of this form is available on the PhD website under the "Current Students/Forms" link.

Student progress reports assess Student Learning Outcomes. They are a representation of student quality of work standards as maintained by the student. If student progress reports are not completed and handed in to the DPC Chair with supervisory reflection by January 1st of every year, the student will be contacted and given an opportunity to submit the progress report within five days of being notified. If no progress report is received, the student's progress will be considered unsatisfactory and they may lose their funding and be counseled out of the PhD program.

The DPC will review the Student Learning Outcomes from the progress reports at the end of the the calendar year. If the progress is not satisfactory, the student will be placed on probationary status and they will lose their funding. After one semester, if their performance has not improved the DPC will recommend administrative removal from the program to the Graduate College.

### Satisfactory Progress

A minimum of three years of full-time graduate study is normally required to complete a doctoral program. The maximum time allowed is eight years from the filing of the student's program of study in the Office of Graduate Studies. Students not making satisfactory progress will be counseled out of the program. This timeline applies as long as the quality of work standards are maintained by the student.

### Leave of Absence

Under extraordinary circumstances, e.g., medical problems, a student may request a leave of absence from the program for a period of no more than one year. The request must be submitted to and approved by the student's supervisory committee and/or Doctoral Program Committee. The request should include necessary modifications to the Plan of Study as a result of the leave.

The leave of absence stops the clock for the total time required for the program and the time required to meet the residency requirement. If a student withdraws in mid-semester and is approved for a leave of absence,

the clock starts at the beginning of the following semester. A student does not have to have met the residency requirement in order to apply for a leave of absence.

If a student does not return to the program within the one year approved for the leave of absence, then the student must submit an application to re-apply to the program. Re-admission to the program is not guaranteed at that point. Please refer to the Graduate Catalog for the complete policy on a leave of absence.

## Grade Appeals

The Grade Appeal Policy for UNO Graduate Courses policy will be followed in determining the course grades that are eligible for appeal. In the event that a doctoral student would like to appeal their grade, the PhD in IT program grade appeal policy and process will be followed. According, to the PhD in IT program grade appeal policy, doctoral students may initiate a grade appeal when they believe their grade for a doctoral course or exam has been arbitrary or capricious (see the Grade Appeal Policy for UNO Graduate College Courses). An "arbitrary or capricious action" is an action taken without regard for the facts or circumstances. The Student Grade Appeal Committee will be assembled by the chair of the Doctoral Program Committee (DPC) and will comprised of eligible representatives or those with no conflict of interest from the DPC and specialization advisory committee. The Student Grade Appeal Committee will adopt the UNO Graduate Council's criteria for determining whether a grade has been assigned in an arbitrary or capricious manner.

The outcome of taking a comprehensive exam is Pass or Fail. There is no option to revise a comprehensive exam, especially one that has received a Fail grade. If a student fails any part of their comprehensive exam, they have the option to retake the entire exam upon the permission of the DPC. If the student would like to appeal their grade on a comprehensive exam, they may follow the above procedures. Please refer to Graduate College Grade Appeals policy (https://www.unomaha.edu/graduate-studies/current-students/quality-standards.php#k).

**CIST 9080 RESEARCH DIRECTIONS IN IT (3 credits)**

The purpose of this core course is to connect doctoral students and faculty on research topics in Information Technology through assignments, presentations and a final term paper/project with their chosen faculty mentor. Topics covered include but are not limited to nature of research in information technology; research problem selection, development, and presentation with special emphasis on the doctoral dissertation; dissertation process; development and crafting of papers for journals; collaboration on research projects; and the review process for journal papers. Upon completion of this course, students should be able to: 1) demonstrate knowledge of research in information technology, including its reference disciplines and 2) develop a proposal for a significant and interesting research problem as a potential dissertation topic. Their understanding of the field and ability to identify research problems in any of these areas will be examined in their Part 1 comprehensive exam.

**Prerequisite(s)/Corequisite(s):** Admission to PhD program in Information Technology or permission of instructor. Not open to non-degree graduate students.

**CIST 9050 COLLOQUIUM ON IT TEACHING (1 credit)**

The purpose of this course is to provide a forum for interaction among doctoral students and faculty on topics of relevance to professional success as teachers/educators in university settings. Students identify teaching areas and faculty mentors to help them gain teaching skills.

**Prerequisite(s)/Corequisite(s):** Admission to PhD program in Information Technology or permission of instructor. Not open to non-degree graduate students.

**CIST 9060 COLLOQUIUM ON IT PROFESSION AND ETHICS (1 credit)**

The purpose of this core course is to provide a forum for interaction among doctoral students and faculty on topics of relevance to professional success as members of the academy.

**Prerequisite(s)/Corequisite(s):** Admission to PhD program in Information Technology or permission of instructor. Not open to non-degree graduate students.

**ISQA 9150 RESEARCH IN INFORMATION TECHNOLOGY**

This core course is intended for students pursuing an advanced graduate degree who have had basic experience with using Information Technology. Research methods in Information Technology involves an overview of the research process specific to problems in IT. Students learn about theories in IT relevant to their areas of research. They identify key components of research problems in IT, understand different types of research processes, develop research questions, and design research projects. They learn to construct research instruments that enable them to collect data. They also learn about the different data collection and analysis tools and techniques. As part of this course, students take the CITI training and achieve the research readiness they need to succeed in the PhD in IT program.

**Prerequisite(s)/Corequisite(s):** Admission to PhD program in Information Technology or permission of instructor. Not open to non-degree graduate students.

**CIST 9900 SPECIAL TOPICS IN INFORMATION TECHNOLOGY (1-3 credits)**

This course is designed to acquaint students with issues which are current to the field or emerging trends in the information technology area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s)/Corequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular topic offerings.

**CIST 9980 INDEPENDENT STUDY IN INFORMATION TECHNOLOGY (1-3 credits)**

This course allows students to research a topic of their interest that is not available in a formal course. The topic to be studied must be agreed upon by the student and the instructor.

**Prerequisite(s)/Corequisite(s):** Permission of the instructor. Not open to non-degree graduate students.

**CIST 9990 DISSERTATION (1-12 credits)**

The dissertation is an original research project conducted and written under the direction of a faculty dissertation committee "supervisory committee". The dissertation provides the student with an opportunity to do original research that contributes to advancing the body of knowledge in information systems and/or information technology.

**Prerequisite(s)/Corequisite(s):** Admission to the Ph.D. program in Information Technology. Admission to candidacy for the Ph.D. degree. Prior to enrolling for dissertation hours, the students must have permission of the supervisory committee. Not open to non-degree graduate students.

**ISQA 9010: Foundations of Information Systems Research**
This course covers the following areas: (1) information systems as an academic discipline including classic readings in IS and its reference disciplines, (2) theory development and evaluation, (3) research methods applicability in IS.
**Credits: 3**
**Prereq:** Doctoral student standing in the information systems areas or with the permission of the instructor; ISQA 8060 or equivalent. Not open to non-degree students.

**ISQA 9020: Technical & Process Issues in Information Systems Research**
This seminar is a survey course on the technical and process issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in technical and process issues with the application of that knowledge to research on information systems. Major topics include: software engineering, programming, data base systems, decision support systems, data warehousing and mining systems, object-oriented systems, adaptive and expert systems, client-service systems, information filtering and multimedia systems, information agents, mobile computing, telecommunications, and electronic commerce.
**Credits: 3**
**Prereq:** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree students.

**ISQA 9030: Behavioral & Organizational Issues in Information Systems**
This seminar is a survey course on the behavioral and organizational issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in behavioral and organizational issues with the application of that knowledge to research on information systems. Major topics include: foundations of behavioral and organizational research in Information Systems; general research on systems design and problem solving; cognitive perspectives; decision making processes; human aspects of computing; computer-mediated communication; systems development; IS implementation; organizational change; organizational structure and new forms; information systems adoption; management of the information systems function; social, cultural, and ethical issues in information systems; and project management.
**Credits: 3**
**Prereq:** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree students.

**ISQA 9900: Advanced Research in Information Systems**
This course provides a format for exploration of highly focused advanced topics of interest to doctoral students in the information systems and/or information technology area. Topics covered will change periodically in keeping with the interests of faculty and students.
**Credits: 3**
**Prereq:** Admission to PhD program in Information Technology or permission of instructor. Not open to non-degree students.
**Cross-list:** COMM-9400

**ISQA 9120: Applied Experimental Design and Analysis**
Constructing and analyzing designs for experimental investigations; completely randomized, randomized complete block and Latin-square designs, split-plot designs, incomplete block designs, confounded factorial designs, nested designs, and treatment of missing data, comparison of designs. The course will use computer-assisted analysis and graphic techniques included in software such as SAS or SPSS.
**Credits: 3**
**Prereq:** ISQA 4150/8156 or consent of instructor. Not open to non-degree students.

**ISQA 9130: Applied Multivariate Analysis**
The use of multivariate analysis for solving business problems. MANOVA, factor, cluster, and discriminant analysis techniques in IT research. The course will use computer-assisted analysis and graphic techniques included in software such as SAS or SPSS.
**Credits: 3**
**Prereq:** ISQA 4150/8156 or consent of instructor. Not open to non-degree students.

**CSCI 9210: Type Systems Behind Programming Languages**
Empirical evidence suggests that a large number of errors made when writing software can be detected by analyzing the behavior of the program from the perspective of type. This course provides an in-depth exploration of various type systems for programming languages.
**Credits: 3**
**Prereq:** CSCI 8000 Not open to non-degree students.

**CSCI 9220: Rewriting and Program Transformation**
This course begins by exploring the foundations of term rewriting. Topics such as unification, confluence, completion and termination are covered. Then a strategic framework is considered in which the application of rewrite rules can be controlled.
**Credits: 3**
**Prereq:** CSCI 8000 Not open to non-degree students.

**CSCI 9340: Computational Intelligence for Data Management**
The course provides students advanced knowledge on computational intelligence methods related to various aspects of data management. Rather than treating computational intelligence and database management systems separately, the course allows students to examine the integration of these two research disciplines. The emphasis is on how to apply computational intelligence methods to various data management problems.
**Credits: 3**
**Prereq:** CSCI 8456 and CSCI 8856 Not open to non-degree students.

**CSCI 9350: Mathematical and Logical Foundations of Data Mining**
With the maturity of data mining techniques, it is extremely important to examine the foundations of data mining. Instead of providing coverage of basic data mining methods, the course will focus on methodology employed in data mining, logical and mathematical foundations of data mining, as well as other issues related to the intrinsic nature of data mining.
**Credits: 3**
**Prereq:** CSCI 8456, CSCI 8856, and CSCI 8390 Not open to non-degree students.

**CSCI 9410: Advanced Topics in Logic Programming**
This course will examine some advanced topics in logic programming, inductive logic programming, and their parallel and distributed implementation. Each advanced topic will be followed by how it has been applied in practice to software development research. Advanced applications such as program analysis and verification will be covered in detail.
**Credits: 3**
**Prereq:** CSCI 8000 and doctoral student standing in Information Technology or the permission of the instructor. Not open to non-degree students.

**CSCI 9420: Intelligent Agent Systems**
This course covers the principles of interaction between agents in multi-agent systems using game theory. Relevant topics studied in this course include competitive games, statistical Bayesian games, cooperative games, and mechanism design. Students will have to implement projects related to the material studied in the course.
**Credits: 3**
**Prereq:** CSCI 3320/8325: Data Structures and Algorithms CSCI 4450/8456: Introduction to Artificial Intelligence Not open to non-degree students.

**CSCI 9710: Foundations of Software Engineering Research**
This course provides guidelines on how to conduct research in the field of software engineering by presenting the research methods, classic readings, and development of theories and their application to real life problems. The main emphasis of the course is to provide opportunity for in-depth study of topics such as modern software engineering development methodologies and process.
**Credits: 3**
**Prereq:** CSCI 8836 or equivalent course and doctoral student standing in Information Technology or permission of the instructor. Not open to non-degree students.

**CSCI 9810: Research Foundations in Theoretical Computing**

This course offers an up-to-date coverage of the contemporary and emerging concepts, models, techniques, and methodologies, and/or the current research results in the fundamental areas of theoretic computing. The course will examine advanced research topics in computer science and engineering, including foundations of automata theory, computability, complexity analysis, computational logics and algorithmic analysis, hybrid dynamic systems theory, number theory, adaptation and learning theory, concepts and principles in computational geometry, stochastic processes, and random optimization. Each topic will be discussed with a perspective of research issues and directions. Active student participation in investigation of the research topics, survey of the current state-of-art, and identifying the future research insights is required. Students will take turn presenting their research results on specific topics. Topics to be covered by the course will vary in different semesters.

**Credits: 3**

**Prereq:** The prerequisites of this course vary depending on the areas to be covered in the semester the course is offered. Good standing in PhD program is required. Permission of the instructor may be required for students to take this course. Not open to non-degree students.