



College of Engineering

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Date: 12 October 2010

To: Randy Smith
Vice Provost, Office of Academic Affairs

From: Ed McCaul 
Secretary, College of Engineering Committee on Academy Affairs (CCAA)

Subject: Semester Conversion Proposal for the Graduate Minor in Computer Science

Attached is a letter from Xiaodong Zhang, Department Chair of Computer Science and Engineering, as well as a semester conversion proposal for their Graduate Minor in Computer Science.

This proposal was reviewed by a subcommittee of CCAA. After reviewing the proposal and having some minor changes made to it the subcommittee recommended to the full committee that it be approved. After a discussion, CCAA unanimously approved the proposal on the 11th of October 2010 and requested that I forward the proposal to you for consideration by CAA. If you have any questions concerning this proposal please let me know.

To: Engineering College Committee on Academic Affairs

From: Xiaodong Zhang, CSE Department Chair

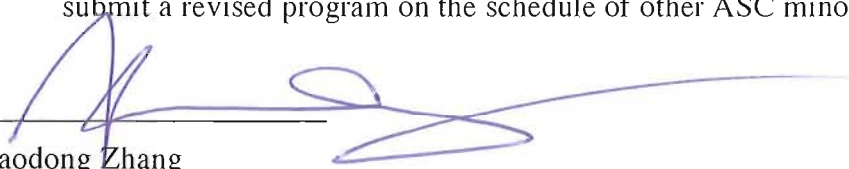
Date: 24 September 2010

Re: Semester Proposal for *Graduate Minor in Computer Science*

The faculty of Computer Science and Engineering are pleased to submit the attached proposal as an addendum to the major program proposals we previously submitted for the BS, MS, and PhD degrees in Computer Science and Engineering. The process used to develop this proposal is the same one used to develop the previously submitted proposals, except that student input in this case was limited to that available via informal conversations with individual students in the current program (see Section 12). The faculty have voted to approve the attached proposal as our semester plan for re-envisioning the current *Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering* to become a *Graduate Minor in Computer Science*, and I also recommend approval. The vote of all CSE graduate faculty members on this proposal was 35 in favor, 0 opposed, 0 abstentions.

The CSE Department currently administers the following other academic programs whose semester conversion proposals are not included in the total package submitted to date. None of these academic programs is being withdrawn; all will be converted to semesters.

- Minor in Computational Science and Engineering (an undergraduate minor program in Engineering; this program, which needs to undergo a pre-approval through the state's Ralph Regula School of Computational Science, will be submitted to the Engineering College Committee on Academic Affairs as soon as practical)
- BS in Computer and Information Science (a program in Arts and Sciences; we will submit a revised program on the schedule of other ASC major programs)
- BA in Computer and Information Science (a program in Arts and Sciences; we will submit a revised program on the schedule of other ASC major programs)
- Minor in Computer and Information Science (a program in Arts and Sciences; we will submit a revised program on the schedule of other ASC minor programs)



Xiaodong Zhang

Robert M. Critchfield Professor, and CSE Department Chair

Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering-to-Graduate Minor in Computer Science

Primary Contacts: Bruce W. Weide (weide.1, 292-1517) and Gagan Agrawal (agrawal.28, 688-8450)

1. Fiscal Unit / Academic Organization

Department of Computer Science and Engineering (1435)

2. Administering College / Academic Group

College of Engineering / Department of Computer Science and Engineering (CSE)

3. Co-administering College / Academic Group

College of Engineering / Department of Electrical and Computer Engineering (ECE)

4. Semester Conversion Designation

b. Re-envisioned with significant changes to program goals and/or curricular requirements

5. Program / Plan Name

Current: Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering (ASE GIS/Minor)

Proposed: Graduate Minor in Computer Science (CS Grad Minor)

6. Type of Program

Current: Graduate interdisciplinary specialization

Proposed: Graduate minor

7. Program / Plan Code Abbreviation

TBD

8. Degree Title

Not applicable

9. Specializations / Sub-plans

Not applicable

10. Program Learning Goals

Not required at this time for graduate programs

11. List of Semester Courses

See Attachment #1: CS Grad Minor Proposed Program Requirements. The program is intended to be very flexible, i.e., the successful candidate must complete 10 cr-hrs of graduate-level CSE courses (including at most 1 cr-hr of CSE 425X) selected in consultation with the CS Grad Minor program coordinator. The “tracks” listed in Attachment #1 should be viewed as guidance for the student about what might be appropriate, based on coherence in terms of student backgrounds and technical content of the courses, but each student may craft an individualized program with the program coordinator.

12. Program Rationale

The Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering was introduced in 2007. Two important factors have led to the changes proposed here:

- The Department of Electrical and Computer Engineering is *not* interested in continuing to co-administer this program under semesters; see Attachment #2. Meanwhile, the Department of Computer Science and Engineering is interested in continuing to administer, indeed in expanding the scope of, the program. This is why the proposal comes from the CSE Department.
- Experience shows that the variety of needs of graduate students from across the campus for graduate-level coursework in computing cannot be met by a program that focuses solely on developing state-of-the-practice skills in applied software engineering. This is still an important customer base, and some students are served well by the existing program, but *more flexibility needs to be available* in order to meet the needs of students with different backgrounds.

The ASE GIS/Minor has served on average about 5 students per year since it was introduced. Based on experience in advising these students and fielding inquiries from others with computing-related interests, we estimate that a similar number of students each year will be eligible and qualified to complete the proposed CS Grad Minor *other than* in the “software engineering” track (which is a direct conversion of the ASE GIS/Minor to the semester offerings of the CSE Department). In other words, this program might serve about 10 students per year.

While most courses have non-trivial prerequisites, we have seen a number of graduate students (e.g., from Mathematics, Statistics, Physics, etc.) who have significant computing backgrounds and who apparently will be able to complete the requirements of one of the new proposed CS Grad Minor tracks without “remedial” undergraduate coursework. Of course, others who are willing to complete such prerequisite coursework (which will not count toward the CS Grad Minor) are also welcome to enter the CS Grad Minor upon completion of said prerequisites.

CSE 425X is any of a few 1 cr-hr courses (currently planned as CSE 4251, 4252, 4253, 4254, and 4255) that teaches someone with programming competence how to program in a new programming language. The specific language most useful to a student in a given discipline is something the student will need to determine in consultation with the CS Grad Minor program coordinator. The limit of 1 cr-hr total from this group of courses is important because the purpose of the minor is not to give a student a superficial knowledge of several programming languages, which would not constitute intellectual content appropriate for a graduate minor.

The coursework identified for the CS Grad Minor program should contribute significantly to graduate students’ research capabilities in their core disciplines. In addition, a transcript designation recognizing graduate-level knowledge and skill in computing should enhance their employability in either industry or academia.

ASE GIS/MINOR-TO-CS GRAD MINOR PROGRAM PROPOSAL — 9/24/10

13. Quarters Curriculum Advising Sheet

See Attachment #3 for the current ASE GIS/Minor program requirements; this is also available at <http://www.cse.ohio-state.edu/grad/ase.shtml>. This document serves as the current ASE GIS/Minor Advising Sheet.

14. Semesters Curriculum Advising Sheet

See Attachment #4 for the proposed CS Grad Minor Advising Sheet.

15. Curricular Map

Not applicable

16. Associated Pre-Major or Area of Interest

Not applicable

17. Credit-Hour Changes

	Number of qtr-cr-hrs in current program	Calculated result for 2/3 of current qtr-cr-hrs	Number of sem-cr-hrs required for proposed program	Change in cr-hrs
Total minimum cr-hrs required for completion of program	15	10.0	10	0.0
Required cr-hrs offered by the unit	15	10.0	10	0.0
Required cr-hrs offered outside of the unit	0	0.0	0	0.0
Required prerequisite cr-hrs not included above	0	0.0	0	0.0

18. Rationale for Significant Change in Credit Hours

Not applicable

19. Transition Policy

No student who begins the ASE GIS/Minor under quarters will have progress toward completion impeded by the transition to semesters. CS Grad Minor requirements beginning Summer 2012 will be those in force for students under semesters; but *every* quarter-credit-hour that would have counted toward an ASE GIS/Minor under the quarter-based program will count (as 2/3 of a semester-credit-hour) toward the requirements for the CS Grad Minor program. If necessary, a revision of specific requirements will be worked out for any ASE GIS/Minor student who is caught in the transition, in consultation with the CS Grad Minor program coordinator.

— Xiaodong Zhang, CSE Department Chair

Most students complete the ASE GIS/Minor in one academic year (Au, Wi, Sp), so it is unlikely that any student will be caught in the transition. Even if this happens and special provisions need to be made under the above policy statement, there are no graduate course sequences in which a

ASE GIS/MINOR-TO-CS GRAD MINOR PROGRAM PROPOSAL — 9/24/10

student might be caught part-way during the switch to semesters, so there is no need for bridge courses in the proposed program.

20. *Assessment Practices*

Not applicable

Attachment #1: CS Grad Minor Proposed Program Requirements

Complete 10 graduate cr-hrs in CSE, including at most 1 cr-hr of CSE 425X, in a coherent individualized program worked out with the CS Grad Minor program coordinator. Some suggested coherent tracks are shown below.

Software Engineering Track	Course Number	Cr-hrs	Completed
Introduction to Object-Oriented Programming	CSE 4221	3	
Software Engineering Techniques	CSE 5231	2	
Software Requirements Analysis	CSE 5232	3	
Distributed Enterprise Computing	CSE 5233	3	
Principles of Programming Languages	CSE 5341	2	
Formal Foundations of Software Engineering	CSE 6231	3	
Intermediate Studies in Software Engineering	CSE 5239	2	
Project: Design, Dev, and Doc of Web Applications	CSE 5901	3	
Capstone Design: Software Applications	CSE 5911	4	
Total Software Engineering Track cr-hrs (≥ 10)			

Foundations/Theory Track	Course Number	Cr-hrs	Completed
Automata and Formal Languages	CSE 5321	2	
Foundations II: Data Structures and Algorithms	CSE 5331	2	
Principles of Programming Languages	CSE 5341	2	
Introduction to Cryptography	CSE 5351	3	
Numerical Methods	CSE 5361	3	
Formal Foundations of Software Engineering	CSE 6231	3	
Computability and Complexity	CSE 6321	3	
Algorithms	CSE 6331	3	
Advanced Algorithms	CSE 6332	3	
Distributed Algorithms	CSE 6333	3	
Foundations of Programming Languages	CSE 6341	3	
Intermediate Studies in Computation Theory	CSE 5329	2	
Intermediate Studies in Algorithms	CSE 5339	2	
Intermediate Studies in Programming Languages	CSE 5349	2	
Intermediate Studies in Cryptography	CSE 5359	2	
Total Foundations/Theory Track cr-hrs (≥ 10)			

Database Track	Course Number	Cr-hrs	Completed
Introduction to Database Systems	CSE 5241	2	
Advanced Database Management Systems	CSE 5242	3	
Introduction to Data Mining	CSE 5243	3	
Intermediate Studies in Databases	CSE 5249	2	
Capstone Design: Information Systems	CSE 5915	4	
Total Database Track cr-hrs (≥ 10)			

Computational Science Track	Course Number	Cr-hrs	Completed
Numerical Methods	CSE 5361	3	
Introduction to Computer Architecture	CSE 5421	2	
Systems II: Introduction to Operating Systems	CSE 5431	2	
Introduction to Parallel Computing	CSE 5441	3	
Intermediate Studies in Parallel Computing	CSE 5449	2	
Total Computational Science Track cr-hrs (≥ 10)			

Artificial Intelligence Track	Course Number	Cr-hrs	Completed
Survey of Artificial Intelligence I: Basic Techniques	CSE 5521	2	
Survey of Artificial Intelligence II: Adv Techniques	CSE 5522	3	
Machine Learning and Statistical Pattern Recog	CSE 5523	3	
Computer Vision for Human-Computer Interaction	CSE 5524	3	
Foundations of Speech and Language Processing	CSE 5525	3	
Introduction to Neural Networks	CSE 5526	3	
Intermediate Studies in Artificial Intelligence	CSE 5539	3	
Capstone Design: Knowledge-Based Systems	CSE 5914	4	
Total Artificial Intelligence Track cr-hrs (≥ 10)			

Computer Graphics Track	Course Number	Cr-hrs	Completed
Computer Game and Animation Techniques	CSE 5541	2	
Real-Time Rendering	CSE 5542	3	
Geometric Modeling	CSE 5543	3	
Intermediate Studies in Computer Graphics	CSE 5559	2	
Project: Design, Dev, and Doc of Interactive Sys	CSE 5902	3	
Capstone Design: Game Design and Development	CSE 5912	4	
Capstone Design: Computer Animation	CSE 5913	4	
Total Computer Graphics Track cr-hrs (≥ 10)			

Information Security Track	Course Number	Cr-hrs	Completed
Introduction to Cryptography	CSE 5351	3	
Intermediate Studies in Cryptography	CSE 5359	2	
Computer Networking and Internet Technologies	CSE 5461	2	
Information Security	CSE 5471	3	
Information Security Projects	CSE 5472	3	
Network Security	CSE 5473	3	
Social, Ethical, and Prof Issues in Computing	CSE 5501	1	
Intermediate Studies in Computer Security	CSE 5479	2	
Total Information Security Track cr-hrs (≥ 10)			

Computer Systems Track	Course Number	Cr-hrs	Completed
Introduction to Computer Architecture	CSE 5421	2	
Systems II: Introduction to Operating Systems	CSE 5431	2	
Operating Systems Laboratory	CSE 5433	3	
Introduction to Parallel Computing	CSE 5441	3	
Computer Architecture	CSE 6421	3	
Operating Systems	CSE 6431	3	
Intermediate Studies in Computer Architecture	CSE 5429	2	
Intermediate Studies in Operating Systems	CSE 5439	2	
Intermediate Studies in Parallel Computing	CSE 5449	2	
Total Computational Science Track cr-hrs (≥ 10)			

Computer Networking Track	Course Number	Cr-hrs	Completed
Computer Networking and Internet Technologies	CSE 5461	2	
Network Programming	CSE 5462	3	
Introduction to Wireless Networking	CSE 5463	3	
Intermediate Studies in Computer Networking	CSE 5469	2	
Network Security	CSE 5473	3	
Distributed Algorithms	CSE 6333	3	
Computer Communication Networks	CSE 6461	3	
Total Computer Networking Track cr-hrs (≥ 10)			

Attachment #2:

Certification that Electrical and Computer Engineering wishes to give up joint administration of this program:

From: "Robert Lee" <lee@ece.osu.edu>
Date: August 9, 2010 11:34:05 AM EDT
To: "'Xiaodong Zhang'" <zhang@cse.ohio-state.edu>
Cc: <weide@cse.ohio-state.edu>, "'Betty Lise Anderson'" <anderson@ece.osu.edu>

Xiaodong,

The Department of Electrical and Computer Engineering currently co-administers the Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering, jointly with the Department of Computer Science and Engineering. ECE is happy to let CSE take over this program entirely, as part of the quarter-to-semester conversion process.

Best Regards, Rob

Robert Lee, Ph.D.
Professor and Chair
Department of Electrical and Computer Engineering
2015 Neil Avenue
Columbus, OH 43210
Phone: (614)-292-2571

Attachment #3: Current Advising Sheet



Graduate Interdisciplinary Specialization/Minor in Applied Software Engineering



Computing has become the key enabler of fabulously rapid advances that have occurred, and that will continue for the foreseeable future, across nearly all disciplines of the academy and throughout all segments of society. In order to conduct state-of-the-art research in many disciplines, especially in engineering and science, some students now must design and develop sophisticated discipline-specific software systems. The Graduate Interdisciplinary Specialization/Minor in *Applied Software Engineering* educates graduate students in state-of-the-practice industrial-strength software technologies that will help them better carry out their primary graduate work when that work entails the development of significant technical software systems.

The Applied Software Engineering Specialization/Minor is not primarily about numerical analysis or high-performance computing. Instead, it focuses on current software technologies and practices that are widely used and followed in the software industry. The courses emphasize how and why designing and developing large software systems is *different in kind* from writing small scripts and other useful but small programs of the sort that might be needed to do calculations for undergraduate engineering and science homework or lab assignments.

Impact for the Student

Completion of the program leads to a transcript designation that can and should be advertised to prospective employers who prefer candidates with not only discipline-specific knowledge but also the knowledge and skill to develop sophisticated technical software systems in their discipline. Many engineering and science graduate students—not just those majoring in computing but often those with traditional engineering and science degrees—find employment with high-tech

companies in jobs where they are expected to help design and develop sophisticated software. Prospective employees who already have the knowledge and skills to develop advanced software systems are very attractive to these employers.

Prerequisites

The program is academically accessible to interested graduate students throughout the university with modest prerequisites: some calculus and some prior programming experience. Graduate students in Engineering, Mathematical and Physical Sciences, and Biological Sciences are nearly certain to have the required background from their undergraduate studies, as are many students from other disciplines where the Applied Software Engineering program could be useful (e.g., Social and Behavioral Sciences such as Economics, Geography, and Psychology).

Curriculum

The program is jointly administered by the Department of Computer Science and Engineering (CSE) and the Department of Electrical and Computer Engineering (ECE). It consists of a total of 15 cr-hrs in these departments and often can be completed in one academic year. Students with little or no background in object-oriented programming take both classes in the Fundamentals Core (see course listing on back). Students already having this background take only the second class in the Fundamentals Core. The remaining credits needed to obtain 15 total are taken in the form of technical elective courses, at least one of which is from the Elective Core.

Faculty and course information on reverse side.

For more details, please see:
<http://www.cse.ohio-state.edu/grad/ase.shtml>

Primary Faculty

Paolo Bucci, Ph.D. The Ohio State University,
Research Scientist, CSE

Furrukh Khan, Ph.D. SUNY at Stony Brook,
Associate Professor, ECE and CSE

Robert Mathis, Ph.D. The Ohio State University,
Adjunct Professor, CSE

Jayashree Ramanthan, Ph.D. Rice University,
Senior Research Scientist, CSE

Rajiv Ramnath, Ph.D. The Ohio State University,
Assistant Professor of Practice, CSE

Paul Sivilotti, Ph.D. Caltech,
Associate Professor, CSE

Bruce W. Weide, Ph.D. Carnegie Mellon University,
Professor, CSE

Getting Started

Prospective students should begin by contacting one of the program advisors, obtaining advice and approval for their technical electives, and completing paperwork indicating their course selections:

Prof. Bruce Weide
(614) 292-1517, weide.1@osu.edu

Prof. Furrukh Khan
(614) 292-4349, khan.1@osu.edu

Note: Graduate students majoring in CSE and ECE may not consider this program a "graduate interdisciplinary specialization". However, ECE graduate students may designate the program as a "graduate interdisciplinary minor" if they complete at least 14 cr-hrs of the coursework in CSE courses, including cross-listed courses taken under CSE course numbers. CSE graduate students may take courses in the program, but completion of the program's curriculum will not be designated on their transcripts.

Courses

All courses are U G 3 unless otherwise noted.

I Fundamentals Core (502 only if needed)

- **CSE 502:** Object-Oriented Programming for Engineers and Scientists (Au)
- **CSE/ECE 668:** Applied Component-Based Programming for Engineers and Scientists (Wi)

II Elective Core (select at least one)

- **CSE/ECE 767:** Applied Use-Case-Driven Object-Oriented Analysis and Design for Engineers and Scientists (Sp, odd-numbered years)
- **CSE/ECE 794R:** Applied Enterprise Distributed Computing for Engineers and Scientists (Sp, even-numbered years)

III Technical Electives (rest of 15 cr-hrs)

- **CSE 541:** Elementary Numerical Methods (Au, Wi, Sp, Su)
- **CSE 551:** Introduction to Information Security (Wi, Sp)
- **CSE 616:** Object-Oriented Systems Analysis (Au, Wi, Sp, Su)
- **CSE 621:** Introduction to High-Performance Computing (Au)
- **CSE 630:** Survey of Artificial Intelligence I: Basic Techniques (Au, Wi, Sp)
- **CSE 670:** Introduction to Database Systems I (Au, Wi, Sp, Su)
- **CSE 680:** Introduction to Analysis of Algorithms and Data Structures (Au, Wi, Sp, Su)
- **ECE 694Z:** Real-time and Embedded System Design Technologies (irregular)
- **ECE 753.02:** Autonomy in Vehicles (Wi, even-numbered years)



Attachment #4: Proposed Advising Sheet



Graduate Minor in Computer Science

Computing has become the key enabler of fabulously rapid advances across nearly all disciplines of the academy and throughout all segments of society. In order to conduct state-of-the-art research in nearly any discipline, students now must contribute to—or even design and develop by themselves—sophisticated discipline-specific software systems. Moreover, looking at problems through the lens of “computational thinking” can bring new insights even when discipline-specific software is not involved. The *Graduate Minor in Computer Science*, administered by the OSU Department of Computer Science and Engineering (CSE), is designed to provide such knowledge and skill. It educates graduate students in conceptual aspects of computing and/or state-of-the-practice industrial-strength software technologies that will help them better carry out their primary graduate work.

Impact for the Student

Completion of the program leads to a transcript designation that can and should be advertised to prospective employers. Candidates with not only discipline-specific knowledge but also a clear conception of computational thinking and the knowledge and skill to contribute to advanced software systems in their discipline are increasingly valuable across academia and industry. Prospective employees who distinguish themselves with the knowledge and skill to communicate clearly with professional software developers, and to help develop discipline-specific software systems, are very attractive to most employers.

Curriculum

The Computer Science Graduate Minor consists of a total of 10 graduate cr-hrs selected in consultation with the program coordinator, including at most 1 cr-hr of CSE 425X.

Prerequisites

Any of several suggested tracks typically can be completed in one academic year. Each of these tracks offers considerable flexibility to the student, but an individualized program (for most relevance, not necessarily one of these tracks) is crafted with each student upon entry to the program. Some courses are academically accessible to interested graduate students throughout the university with modest prerequisites: mathematical maturity and some prior programming experience. Graduate students in Engineering, Mathematics, Physical Sciences, and Biological Sciences are likely to have the required background from their undergraduate studies, as are many students from other disciplines where the Computer Science Graduate Minor could be most useful (e.g., Social and Behavioral Sciences such as Economics, Geography, Linguistics, and Psychology). Some courses require specific undergraduate prerequisite background in mathematics or programming beyond the generic competencies described above. While courses providing such background may be taken by non-CSE graduate students here at OSU, they generally do not count for graduate credit (and do not count as part of the minor).

Getting Started

Prospective students should begin by contacting the program coordinator, obtaining advice and approval for their planned program, and completing paperwork with course selections. Contact information for program coordinator:

Prof. Bruce W. Weide
(614) 292-1517, weide.1@osu.edu

Suggested tracks and courses listed on reverse.
For more details, please see:
<http://www.cse.ohio-state.edu/grad/minor.shtml>

Software Engineering Track	Course Number	Cr-hrs
Introduction to Object-Oriented Programming	CSE 4221	3
Software Engineering Techniques	CSE 5231	2
Software Requirements Analysis	CSE 5232	3
Distributed Enterprise Computing	CSE 5233	3
Principles of Programming Languages	CSE 5341	2
Formal Foundations of Software Engineering	CSE 6231	3
Intermediate Studies in Software Engineering	CSE 5239	2
Project: Design, Dev, and Doc of Web Applications	CSE 5901	3
Capstone Design: Software Applications	CSE 5911	4
Total Software Engineering Track cr-hrs (≥ 10)		

Foundations/Theory Track	Course Number	Cr-hrs
Automata and Formal Languages	CSE 5321	2
Foundations II: Data Structures and Algorithms	CSE 5331	2
Principles of Programming Languages	CSE 5341	2
Introduction to Cryptography	CSE 5351	3
Numerical Methods	CSE 5361	3
Formal Foundations of Software Engineering	CSE 6231	3
Computability and Complexity	CSE 6321	3
Algorithms	CSE 6331	3
Advanced Algorithms	CSE 6332	3
Distributed Algorithms	CSE 6333	3
Foundations of Programming Languages	CSE 6341	3
Intermediate Studies in Computation Theory	CSE 5329	2
Intermediate Studies in Algorithms	CSE 5339	2
Intermediate Studies in Programming Languages	CSE 5349	2
Intermediate Studies in Cryptography	CSE 5359	2
Total Foundations/Theory Track cr-hrs (≥ 10)		

Database Track	Course Number	Cr-hrs
Introduction to Database Systems	CSE 5241	2
Advanced Database Management Systems	CSE 5242	3
Introduction to Data Mining	CSE 5243	3
Intermediate Studies in Databases	CSE 5249	2
Capstone Design: Information Systems	CSE 5915	4
Total Database Track cr-hrs (≥ 10)		

Computational Science Track	Course Number	Cr-hrs
Numerical Methods	CSE 5361	3
Introduction to Computer Architecture	CSE 5421	2
Systems II: Introduction to Operating Systems	CSE 5431	2
Introduction to Parallel Computing	CSE 5441	3
Intermediate Studies in Parallel Computing	CSE 5449	2
Total Computational Science Track cr-hrs (≥ 10)		

Artificial Intelligence Track	Course Number	Cr-hrs
Survey of Artificial Intelligence I: Basic Techniques	CSE 5521	2
Survey of Artificial Intelligence II: Adv. Techniques	CSE 5522	3
Machine Learning and Statistical Pattern Recog	CSE 5523	3
Computer Vision for Human-Computer Interaction	CSE 5524	3
Foundations of Speech and Language Processing	CSE 5525	3
Introduction to Neural Networks	CSE 5526	3
Intermediate Studies in Artificial Intelligence	CSE 5539	3
Capstone Design: Knowledge-Based Systems	CSE 5914	4
Total Artificial Intelligence Track cr-hrs (≥ 10)		

Computer Graphics Track	Course Number	Cr-hrs
Computer Game and Animation Techniques	CSE 5541	2
Real-Time Rendering	CSE 5542	3
Geometric Modeling	CSE 5543	3
Intermediate Studies in Computer Graphics	CSE 5559	2
Project: Design, Dev, and Doc of Interactive Sys	CSE 5902	3
Capstone Design: Game Design and Development	CSE 5912	4
Capstone Design: Computer Animation	CSE 5913	4
Total Computer Graphics Track cr-hrs (≥ 10)		

Information Security Track	Course Number	Cr-hrs
Introduction to Cryptography	CSE 5351	3
Intermediate Studies in Cryptography	CSE 5359	2
Computer Networking and Internet Technologies	CSE 5461	2
Information Security	CSE 5471	3
Information Security Projects	CSE 5472	3
Network Security	CSE 5473	3
Social, Ethical, and Prof Issues in Computing	CSE 5501	1
Intermediate Studies in Computer Security	CSE 5479	2
Total Information Security Track cr-hrs (≥ 10)		

Computer Systems Track	Course Number	Cr-hrs
Introduction to Computer Architecture	CSE 5421	2
Systems II: Introduction to Operating Systems	CSE 5431	2
Operating Systems Laboratory	CSE 5433	3
Introduction to Parallel Computing	CSE 5441	3
Computer Architecture	CSE 6421	3
Operating Systems	CSE 6431	3
Intermediate Studies in Computer Architecture	CSE 5429	2
Intermediate Studies in Operating Systems	CSE 5439	2
Intermediate Studies in Parallel Computing	CSE 5449	2
Total Computational Science Track cr-hrs (≥ 10)		

Computer Networking Track	Course Number	Cr-hrs
Computer Networking and Internet Technologies	CSE 5461	2
Network Programming	CSE 5462	3
Introduction to Wireless Networking	CSE 5463	3
Intermediate Studies in Computer Networking	CSE 5469	2
Network Security	CSE 5473	3
Distributed Algorithms	CSE 6333	3
Computer Communication Networks	CSE 6461	3
Total Computer Networking Track cr-hrs (≥ 10)		