THE UNIVERSITY OF WISCONSIN OSHKOSH™

COMPUTER SCIENCE DEPARTMENT

Advisement Bulletin

2014-2015

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Reasons for Considering a Computing Major at UWO

There are many good reasons for choosing a computing major. The present employment outlook is excellent:

- CareerCast, a nation-wide job service recently conducted a study and reached the conclusion that software engineer is the best job of 2011. According to the study, their selection of software engineer for this title "can be attributed to two emerging industries: web applications and cloud computing. A proliferation of companies making applications for smartphones and tablets, along with the push to develop cloud software hosted entirely online, has made the job market for Software Engineers broader and more diverse. And a diverse job market brings improvements in stress factors such as Growth Potential and Competitiveness, as workers become less beholden to employers or vulnerable to outsourcing."

- What's it like to be a computer scientist? The perspective of Marissa Mayer, CEO of Yahoo, may surprise you. Read more about it on our website.

- According to the "Recruiting Trends 2010—2011" report that is published by the Collegiate Employment Research Institute at Michigan State University, "students graduating at all degree levels in computer science and related IT fields will have a favorable job market. Already in short supply, these students will see expanded opportunities due to the investments companies are making in technology." The report projects that employment opportunities for computer science graduates will increase by 18 percent.

- According to the recently released 2010 Taulbee Report from the Computing Research Association:

  "Computing careers are projected to be the fastest growing professional occupations over the next decade. They are among the tops in salary and ranked as some of the best jobs in America. And they're filled with tremendous intellectual challenges, excitement, and the opportunity to change the world."

- According to a 2010 survey conducted by the National Association of Colleges and Employers computer science earns the fourth highest average starting salary among all majors.

- A wide variety of career paths in computer science offer an opportunity to work with others to solve interesting problems while making a meaningful contribution to science, business, and society.

- According to the national Bureau of Labor Statistics, "Employment of computer scientists is expected to grow by 24 percent from 2008 to 2018, which is much faster than the average for all occupations."

How will UW Oshkosh prepare you for a Computer Science career?

- The UW Oshkosh Computer Science emphasis is nationally accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 150, Baltimore, MD 21202-4012, telephone: (410) 347-7700. The Computer Science emphasis is one of the select few ABET-accredited Computer Science programs in the state of Wisconsin. Learn why ABET accreditation makes a difference on our website.

- We have an Advisory Board composed of alumni and employers. What are they saying about our program? Read excerpts from their 2005 report and their 2009 report. We'll be happy to send you more information about the Advisory Board and complete copies of all of their reports. Just contact the department chair.

- UW Oshkosh computing majors land internship positions at companies in the Fox Valley and beyond. Through these opportunities students gain valuable job experience, earn college credit, and build practical knowledge and teamwork skills.

- UW Oshkosh computer science graduates have been hired by: IBM, Oracle, Intel, Google, Kimberly Clark, American Family Insurance, Thrivent, Miles Kimball, Epic Systems, Quadgraphics, and Oracular Systems, just to name a few.

- Our undergraduate majors have the opportunity to work with computer science faculty on their research projects, and also develop and conduct their own research with faculty guidance. In 2009 we were awarded a National Science Foundation Research Experience for Undergraduates grant that allowed us to fund eight students each summer until 2012 in collaborative research projects. Read more about this REU site award on our website.

- Our students gain valuable hands-on experience with Java, C++, Microsoft Windows, Linux, and database platforms.

- UW Oshkosh has excellent computing facilities with over 400 PC's in student labs, including a Wintel lab and a Linux lab dedicated to computer science students. High-speed Internet access is available in dorm rooms, and wireless access is widely available in campus buildings.

Admission & Graduation Requirements

As of this writing the Computer Science department has no admission requirements for the Computing major. Therefore any student who chooses to do so may enroll as a Computing major.

To be eligible for graduation, students must meet all requirements for the degree being sought in addition to earning a minimum grade point average of 2.00 in all courses required for the Computing major or minor.

In addition to University and College requirements, students must have a minimum grade point average of 2.00 in those computer science (CS) courses numbered 300 or above that are used to satisfy the requirements of the Computing major excluding CS 399 and CS 490.

Please note that this statement implies that if a student completes more than the minimum number of courses required for a specific emphasis, the student may designate those courses that will be used for computing the grade point average when more than one choice is possible. The resulting set of designated courses must satisfy the requirements of a specific emphasis of the Computing major.

Objectives (revised Spring 2013)

Three to five years after graduation, our typical alumni will:

1. Advance beyond initial entry-level positions as computing professionals or have made significant progress toward a graduate degree in computing.

2. Use the background they have acquired in a wide range of areas in computer science during their undergraduate study as a basis for continued growth of their professional knowledge and skills.

3. Use teamwork skills effectively in the development of complex software systems.

4. Use communication skills to advantage within the organizational structure of workplaces that are becoming increasingly diverse and interconnected among different groups including, but not necessarily limited to, those groups based on racial, gender, age, and religious backgrounds.

5. Demonstrate strong professional ethics in all of their computing endeavors.

Learning Outcomes

General outcomes that guide the specific learning outcomes for individual courses.

Students graduating with a degree in computing with the computer science emphasis will have:

- Outcome A: An ability to apply knowledge of computing and mathematics appropriate to the discipline

- Outcome B: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

- Outcome C: An ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs

- Outcome D: An ability to function effectively on teams to accomplish a common goal

- Outcome E: An understanding of professional, ethical, legal, security and social issues and responsibilities

- Outcome F: An ability to communicate effectively with a range of audiences

- Outcome G: An ability to analyze the local and global impact of computing on individuals, organizations and society

- Outcome H: Recognition of the need for and an ability to engage in continuing professional development

- Outcome I: An ability to use current techniques, skills and tools necessary for computing practice

- Outcome J: An ability to apply mathematical foundations, algorithmic principles and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices

- Outcome K: An ability to apply design and development principles in the construction of software systems of varying complexity

Prerequisites and Repeating Courses

Prerequisites

The computer science department has established prerequisites for each course so that students will be adequately prepared for the topics covered in the course. This allows the instructor to proceed with the course in a manner that assures quality in the program.

The department strictly enforces the prerequisite policy. You should not take courses unless you satisfy the prerequisites. Otherwise, when the deficiency is detected, you will have to drop the course. All courses are checked. See Enrollment Policy Without Prerequisites on our website for additional details.

Repeating Courses

The College of Letters and Science and the computer science department permit students to repeat a given computer science course **one time only**. Note that this policy includes transfer courses. A very important consequence of this policy is that a student who does not earn a grade of C or better in certain courses that are prerequisites for a required course must withdraw from the Computing major. For example, suppose a student earns a D grade in CS 271 (Data Structures). Then s/he repeats it and earns a C- grade. Because CS 271 is a prerequisite for most 300-level courses, he or she will not be permitted to major in Computing.

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Core Courses

These courses are required of all Computing majors.

Course	Credits
Math 212 Mathematics for Computer Science (was numbered Math 122 prior to Fall 2009)	3 cr.
CS 221 Object Oriented Design and Programming I	3 cr.
CS 251 Computer Architecture and Assembly Language	3 cr.
CS 262 Object Oriented Design and Programming II	4 cr.
CS 271 Data Structures	4 cr.
CS 331 Programming Languages	3 cr.
CS 350 Ethical Issues in Computing	1 cr.
Physics 311 Digital Instrumentation	4 cr.

One of the following:

CS 399 Internship in Computer Science	3 cr.
CS 490 Practicum in Computer Science	3 cr.

Total: 28 cr.

Important Note:

The Physics 311 course requirement also satisfies the one-semester laboratory science course requirement for the B.S. degree, as long as the two-course laboratory science sequence is taken from courses in a department other than Physics.

Computer Science Emphasis

This emphasis focuses on the fundamental practical and theoretical foundations of computer science, providing an in-depth understanding of both the software and hardware components of computer systems. It is appropriate for students preparing for careers in scientific computing or research, and for students planning to pursue graduate degrees.

This emphasis is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 150, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

 Requirements in addition to the computer science core:

Course	Credits
CS 310 Computer Organization and Design	3 cr.
CS 321 Algorithms	3 cr.
CS 341 Software Engineering I	3 cr.
CS 381 Theory of Computing	3 cr.
CS 421 Operating Systems	3 cr.
CS 431 Compilers	3 cr.
CS 499 Computer Science Assessment	0 cr.
Math 171 Calculus I	4 cr.
Math 172 Calculus II	4 cr.
Math 301 Introduction to Probability and Statistics	3 cr.
Electives: 6 credits from the elective courses list. The chosen electives must not appear above as requirements for the computer science emphasis.	6 cr.

Total   35 cr.

<u>Important Notes:</u>

1. The Computer Science Emphasis is open only to students pursuing the B.S. degree.

2. The math and science requirements of the CS emphasis necessitate completion of Mathematics 171, 172, 212, 301; CS 381; Physics 311; plus an additional 11 units (credits) from other math and science courses. In selecting courses for these additional 11 units (credits), science courses must be chosen to insure the student meets the general university natural science requirement for a B.S. degree, and math courses must be numbered 222 or above.

Software Engineering Emphasis

This emphasis focuses on knowledge and skills for the design, development, maintenance, and management of software, including software for the operation of instrumentation. It is appropriate for students preparing for careers as systems programmers, systems analysts, software engineers, or computer-based instrumentation specialists.

Requirements in addition to the computer science core:

Course	Credits
CS 321 Algorithms	3 cr.
CS 341 Software Engineering I	3 cr.
CS 342 Software Engineering II	3 cr.
CS 361 Database Systems	3 cr.
Either Math 171 Calculus I or Math 206 Mathematics for Business Analysis II	4 cr.
Either Math 201 Applied Statistics, Math 301 Introduction to Probability and Statistics, or Econ 210 Economic and Business Statistics	3 cr.
Electives: 12 credits from the elective courses list. The chosen electives must not appear above as requirements for the Software Engineering emphasis.	12 cr.
Total	**31 cr.**

Elective Courses

Computer Science elective courses (formerly known as 'List A')

1. CS 300 Artificial Intelligence

2. CS 310 Computer Organization and Design

3. CS 321 Algorithms

4. CS 341 Software Engineering I

5. CS 342 Software Engineering II

6. CS 346 Web Software Development

7. CS 361 Database Systems

8. CS 371 Computer Graphics

9. CS 381 Theory of Computing

10. CS 391 Data Communication and Computer Networks

11. CS 421 Operating Systems

12. CS 431 Compilers

13. CS 480 Topics in CS

Course Rotation

This is the rotation schedule for upper-level courses.
The computer science department will attempt to offer upper-level courses according to the following rotation. The schedule could be altered due to lack of resources or low enrollments.

The following courses will be offered once per year:

Fall Semester
CS 321 Algorithms
CS 341 Software Engineering I
CS 346 Web Software Development
CS 431 Compilers

Spring Semester
CS 331 Programming Languages
CS 342 Software Engineering II
CS 350 Ethical Issues in Computing
CS 361 Database Systems
CS 421 Operating Systems

The following courses will be offered every third semester

Fall 2014
CS 310 Computer Organization and Design
CS 371 Computer Graphics

Spring 2015
CS 391 Data Communication and Computer Networks
CS 480 Computer Science Topics

Fall 2015
CS 300 Artificial Intelligence
CS 381 Theory of Computing

Course Descriptions

Courses

100 Level: 125, 142

200 Level: 221, 251, 262, 271

300 Level: 300, 310, 314, 321, 331, 341, 342, 346, 347, 350, 361, 371, 381,391, 399

400 Level: 421, 431, 480, 490

CS 125 Web Site Development (3 units)

An introduction to the tools for developing World Wide Web pages. Topics covered include: Internet history, overview of file transfer, remote login, electronic mail, introduction to Hyper Text Markup Language (HTML), incorporating graphics, clip art and other multimedia materials, techniques and principles of effective presentation and uploading files to a server.

This course does not apply toward the Computing major or minor. Not open to students who have completed CS 271.

Prerequisite: None. (Fall or Fall Interim, Spring)

CS 142 Elementary Programming in Visual Basic (3 units)

A service course in computer programming using the language Visual Basic. Topics covered include problem solving, algorithms, selection statements, repetition, arrays, functions and sub-programs.

This course does not apply toward the Computing major or minor. Not open to students who have completed CS 271.

Prerequisite: Math-103 with a grade of C or better, or qualifying for either Math-104 or Math-171 via Math Placement Test. Not open to students who have completed CS 271. (Fall, Spring)

CS 221 Object-Oriented Design and Programming I (3 units)

A first course in problem solving, software design, and computer programming using an object-oriented language. Problem solving/software design techniques include: flow charts, pseudo code, structure charts, structure charts, and UML class diagrams. Data structures and algorithms include: arrays, characters strings, Linear search. Programming topics include; data types assignment statements, standard input/output, selection, repetition, functions/methods, parameters, scope of identifiers, debugging.

Prerequisite: A grade of C or better in Math 104 or Math 108 or Math 206 or Computer Science 142, or qualifying for Math 171 via the Mathematics Placement Exam. (Fall, Spring)

CS 251 - Computer Architecture and Assembly Language (3 units)

An introduction to RISC-based instruction set architecture. Topics include: data representation, assembly language programming, run-time storage management, pointers and references as exemplified in the C++ programming language, and introduction to system software.

Prerequisite: Computer Science 221 with a grade of C or better. (Fall, Spring)

CS 262 Object-Oriented Design and Programming II (4 units)

A second course in problem solving, software design, and computer programming using an object-oriented language. Problem solving/software design topics include: abstract data types, universal modeling language (UML), simple recursion, unit testing, event-handling, simple concurrency. Data structures and algorithms include: binary search, simple sorting algorithms, use of collection classes and their iteration protocols, sequential file processing. Additional topics include: inheritance, polymorphism, graphical user interfaces, simple use of threads.

Prerequisite: Mathematics 108 or equivalent with a grade of C or better, or qualifying for a higher level mathematics course via the Mathematics Placement exam, and Computer Science 221 or equivalent with a grade of C or better. (Fall, Spring)

CS 271 Data Structures (4 units)

A course surveying the fundamental methods of representing data and the algorithms that implement and use those data representation techniques. Data structures and algorithms include; linked lists, stacks, queues, trees, heaps, priority queues, hashing, searching, sorting, data compression, graphs, recursion. Analysis topics include: elementary big-O analysis, empirical measurements of performance, time/space trade-offs, and identifying differences among best, average, and worst case behaviors.

Prerequisite: Computer Science 262 with a grade of C or better and either completion of Computer Science 251 with a grade of C or better or concurrent registration in Computer Science 251. (Fall, Spring)

CS 300 Artificial Intelligence (3 units)

This course is a survey of existing techniques in the field of artificial intelligence. An introduction to the areas of robotics, theorem proving, heuristic programming, natural language processing, neural networks, and game playing is presented. Students are expected to demonstrate mastery via computer programs using the techniques of artificial intelligence.

Prerequisite: CS 271 with a grade of C or better. (Every 3rd semester)

CS 310 Computer Organization and Design (3 units)

An introduction to digital logic and computer hardware organization. The students are introduced to elementary Boolean algebra and switching theory as related to computer architecture. Emphasis is given to the design of Central Processing Units, Arithmetic and Logic Units, and main memories. A comparison of alternate computer organizations is presented.

Prerequisite: CS 251 and Math-212, with grade of C or better. (Every 3rd semester)

CS 314 Practice for ICPC competition (1 unit, repeatable)

This course is taken by students participating in the November ACM International Collegiate Programming Contest. During the course and prior to their participation in the contest, students practice team-oriented problem-solving strategies in areas that often arise in the problems that are given during the contest. These areas include data structures, string manipulation, combinatorics, graph algorithms, dynamic programming, and computational geometry.

Prerequisite: Departmental consent, offered each fall in conjunction with the November competition.

CS 321 Algorithms (3 units)

Algorithm design techniques including brute-force, backtracking, divide-and-conquer, dynamic programming and greedy algorithms. Other topics include big-O and amortized analysis, recurrence relations in the analysis of recursive algorithms, numerical algorithms, pattern matching, data integrity, authentication, and encryption.

Prerequisite: Computer Science 271 and Math 212 with a grade of C or better. (Fall)

CS 331 Programming Languages (3 units)

A study of programming languages. Topics covered include: formal syntactic description, methods of implementation, and language features such as recursion, block structure, string processing, and list processing. Specific high level programming languages are studied to demonstrate the use of these language features.

Prerequisite: CS 271 with a grade of C or better. (Spring)

CS 341 Software Engineering I (3 units)

This course will provide an in-depth study and analysis of at least one large scale software system. Students will analyze, design, and partially implement an extensive software project. Case studies will address major system concerns such as specification, classification, inter-relationships, validation, and evaluation. Other topics include the use of UML, prototyping, data flow diagrams and CASE tools.

Prerequisite: CS 271 with a grade of C or better OR Junior-level standing and CS 262 with a grade of C or better. (Fall)

CS 342 Software Engineering II (3 units)

Software Engineering is the second of a two-semester sequence on the topic of modern Software Engineering tools and techniques. Topics covered include Design Patterns, the Unified Modeling Language (UML), Component-based Software Development, Advanced OO Design and Analysis, Refactoring, and other techniques such as Extreme Programming. An extensive software development project will allow for practical application of the discussed techniques.

Prerequisite: CS 271 and CS 341, each with a grade of C or better. (Spring)

CS 346 Web Software Development (3 units)

An introduction to the tools for developing internet applications. Topics covered include: Internet history, the HyperText Markup Language, graphic images and manipulation, multimedia, programming in the JavaScript and PERL languages.

Prerequisite: CS 262 with a grade of C or better. (Fall)

CS 347 Introduction to Usability (3 units)

This course presents the basic theory and professional views on design and usability, with an emphasis on human-computer interaction in web-based environments. The nature of life in general requires an understanding of how people think and act. What makes a well-designed door versus a poorly designed door? Understanding the answer scientifically is based on understanding people and usability, not the mechanics of doors. This class will focus on several basic principles that range from defining usability, design, sketches and how to evaluate usability. A case study will be conducted using high-level psychology and visual perception concepts that often pertain to usability.

Prerequisites: Computer Science 142 or Computer Science 221, and Math 201 or Math 301 or Econ 210 or Psychology 203, and junior standing.(Spring)

CS 350 Ethical Issues in Computing (1 unit)

A study of the evolution of computing, its implications for society, and the ethical issues underlying those implications. This course will focus on reading the current literature regarding these issues and on presenting the pros and cons of such issues in both oral and written fashion. The course is required for all Computing majors.

Prerequisites: Junior standing and completion of Computer Science 262 wih a grade of C or better. (Spring)

CS 361 Database Systems (3 units)

An introduction to database processing with emphasis on database techniques, design, and modeling. Programming projects include implementation of selected database processing methods and the use of database software.

Prerequisite: CS 271 with a grade of C or better. (Spring)

CS 371 Computer Graphics (3 units)

An introduction to the mathematics, data structures, and algorithms used to create both 2D and 3D graphical output. 2D topics include viewing transformation, clipping, scan conversion, geometric transformations, hierarchical modeling and animation. 3D topics include projections, viewing systems, back face culling, polygon clipping, wireframe images, visible surface algorithms, Phong reflection model, Gouraud and Phong shading techniques, color dithering, color quantization, ray tracing and Bezier patches.

Prerequisite: CS 262 and Math-171 or Math 206 each with a grade of C or better. (Every 3rd semester)

CS 381 Theory of Computing (3 units)

An introduction to the basic concepts in the theory of computing. Topics covered will include automata theory, formal languages, Turing machines, the Chomsky Hierarchy, and undecidability.

Prerequisite: CS 271, and Math-212 or Math-222 all with a grade of C or better. (Every 3rd semester)

CS 391 Data Communication and Computer Networks (3 units)

An introductory course which covers the basic concepts in data communication and computer networks. Topics covered will include the nature of data communication, characteristics of computer networks, the ISO-OSI network protocol layers, error detection and correction codes, and network performance considerations.

Prerequisite: CS 251, CS 271 and Math-212 each with a grade of C or better. (Every 3rd semester)

CS 421 Operating Systems (3 units)

An introduction to operating systems concepts. Topics covered include: interrupts, memory allocation, virtual memory techniques, process scheduling and synchronization, deadlocks, resource allocation, and file systems. A major programming project will be assigned to provide experience with operating system design.

Prerequisite: CS 271 and Math-212, both with a grade of C or better. (Spring)

NOTE: The Computer Science Department will accept courses similar to CS 421 from all other schools as counting toward the list of "elective courses," but not the list of "required courses."

CS 431 Compilers (3 units)

An introduction to compiler writing techniques for translating a higher level programming source language into a lower level target language. Topics to be covered include: definition of programming languages, lexical and syntactic analysis, low level code generation and optimization, run time systems, and error detection, reporting, and recovery. A major programming project will be assigned to provide experience with compiler design.

Prerequisite: Completion of Math-212 with a grade of C or better and completion of or concurrent registration in CS 331. (Fall)

NOTE: The Computer Science Department will accept courses similar to CS 431 from all other schools as counting toward the list of "elective courses," but not the list of "required courses."

CS 480 Topics in CS (3 units)

A topic of current interest in computer science will be investigated by faculty and qualified students. In addition to lectures by faculty, the students will be responsible for research and presentation of selected aspects of the topic. The course may be repeated for credit if the topic is different, and the student has the consent of department.

Prerequisite: Junior-level standing and consent of the instructor. (Every 3rd Semester)

Note: In Spring 2015, the topic of this course will be *Mobile Computing*. The course will be taught by Dr. Erik Krohn. However, since the pre-requisite for this course varies depending on what is being covered in it, TitanWeb will ask for "instructor consent" before you can enroll.   To get the instructor consent necessary to enroll in the course, contact Professor Krohn.

Practicum and Internship

The courses CS 399 Internship in Computer Science and CS 490 Practicum in Computer Science are designed to be the capstone courses for the major or minor. Either course satisfies the Writing Emphasis requirement in the Computer Science Department. Each semester a faculty member in the Computer Science department is assigned the duties of being the "Practicum & Internship Coordinator." The name of and the times to see the coordinator are posted in the departmental office each semester.

CS 399 Internship in Computer Science Credits (3 units)

An internship experience with a cooperating organization or corporation to provide on-the-job learning. This course satisfies the Writing Emphasis requirement for the Computing major.

The internship guidelines and application form are online.

Prerequisites: 75 credits toward graduation, six credits of 300-400 level Computer Science courses. Concurrent registration in Intrdscp 208 (Professional Career Skills in Math and Natural Science, 1 credit) or completion of Intrdscp 208 with a passing grade.

CS 490 Practicum in Computer Science (3 units)

A project-oriented course that brings together the material learned in previous computer science courses. The student will investigate and solve a problem(s) under supervision. This course satisfies The Writing Emphasis requirement for the Computing major.

The practicum guidelines and application form are online.

Prerequisite: 75 credits toward graduation and six credits of 300-400 level Computer Science courses. Concurrent registration in Intrdscp 208 (Professional Career Skills in Math and Natural Science, 1 credit) or completion of Intrdscp 208 with a passing grade.

The Computer Science Minor

The Common Core (14 credits)

These courses are required of all computer science minors.

Course	Credits
CS 221 Object Oriented Design and Programming I	3 cr.
CS 251 Computer Architecture and Assembly Language	3 cr.
CS 262 Object Oriented Design and Programming II	4 cr.
CS 271 Data Structures	4 cr.
Total	**14 cr.**

Elective Computer Science Courses (9 credits)

Any **three** courses may be selected from the following upper-division offerings.

1. CS 300 Artificial Intelligence
2. CS 310 Computer Organization and Design
3. CS 321 Algorithms
4. CS 331 Programming Languages
5. CS 335 Windows and GUI Programming
6. CS 341 Software Engineering I
7. CS 342 Software Engineering II
8. CS 346 Web Software Development
9. CS 361 Database Systems
10. CS 371 Computer Graphics
11. CS 381 Theory of Computing
12. CS 391 Computer Networks
13. CS 421 Operating Systems

14. CS 431 Compilers

15. CS 480 Topics in CS

16. CS 490 Practicum in Computer Science

Total: 23 cr.

Progress Checklist

CS Emphasis	
Computer Science Required:	**Computer Science Electives:**

Computer Science Required:

1. CS 221 _____
2. CS 251 _____
3. CS 262 _____
4. CS 271 _____
5. CS 310 _____
6. CS 321 _____
7. CS 331 _____
8. CS 341 _____
9. CS 350 _____
10. CS 381 _____
11. CS 421 _____
12. CS 431 _____
13. One of:
    1. CS 399 _____
    2. CS 490 _____

Computer Science Electives:

1. _____
2. _____

Mathematics Required:

1. Math-171 _____
2. Math-172 _____
3. Math-212 _____
4. Math-301 _____

Physics Required:

1. Physics 311 _____

SE Emphasis	
Computer Science Required:	Computer Science Electives:
1. CS 221 _____	1. _____
2. CS 251 _____	2. _____
3. CS 262 _____	3. _____
4. CS 271 _____	4. _____
5. CS 321 _____	Mathematics Required:
6. CS 331 _____	
7. CS 341 _____	1. Calculus _____
8. CS 342 _____	2. Math-212 _____
9. CS 350 _____	3. Statistics _____
10. CS 361 _____	Physics Required:

11. One of:
  1. CS 399 _____
  2. CS 490 _____
	1. Physics 311 _____

Students Notes