

# REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN COMPUTER SCIENCE/MASTER OF SCIENCE

B.S. Portion of the Program Accredited by the Computing Accreditation Commission of ABET, <http://www.abet.org>

## GALLOGLY COLLEGE OF ENGINEERING

### THE UNIVERSITY OF OKLAHOMA

For Students Entering the Oklahoma State System for Higher Education  
**Summer 2018 through Spring 2019**

**GENERAL REQUIREMENTS**  
Total Credit Hours . . . . . **138-142**  
**Minimum Retention/Graduation Grade Point Averages:**  
Overall - Combined and OU . . . . . **3.25**  
Major - Combined and OU . . . . . **3.25**  
Curriculum - Combined and OU . . . . . **3.25**  
**A minimum grade of C is required for each course in the curriculum.**

Computer Science  
**A235**  
Bachelor of Science in  
Computer Science/Master of  
Science (Computer Science)  
**F235 Q146**

**OU encourages students to complete at least 29 hours of applicable coursework each year to have the opportunity to graduate in five years.**

| Year   | FIRST SEMESTER   | Hours   | SECOND SEMESTER   | Hours        |
|--|--|---|---|--------------|
| <b>FRESHMAN</b>  | ENGL 1113, Prin. of English Composition (Core I)               | 3   | ENGL 1213, Prin. of English Composition (Core I), <b>or</b> | 3            |
|  | ❖MATH 1914, Differential and Integral Calculus I (Core I)      | 4   | EXPO 1213, Expository Writing (Core I)                      | 4            |
|  | ENGR 1411, Freshman Engineering Experience                     | 1   | ❖MATH 2924, Differential and Integral Calculus II           | 4            |
|  | @C S 1323, Intro. to Computer Prog. for Programmers, <b>or</b> | 1-4   | C S 2334, Programming Structures & Abstractions             | 4            |
|  | 1321, Intro. to Java for Experienced Programmers, <b>or</b>    |   | #† Approved Elective: Natural Science (Core II)             | 3-5          |
|  | 1324, Intro. to Computer Prog. for Non-Programmers             |   |   |              |
|  | † Approved Elective: Artistic Forms (Core IV)                  | 3   |   |              |
|  | <b>TOTAL CREDIT HOURS</b>                                      | <b>12-15</b>                                  | <b>TOTAL CREDIT HOURS</b>                                   | <b>14-16</b> |
| <b>SOPHOMORE</b>   | ❖MATH 2934, Differential and Integral Calculus III             | 4   | ▲PHYS 1311, General Physics Lab I                           | 0-1          |
|  | C S 2813, Discrete Structures, <b>or</b>                       | 3   | PHYS 2514, General Physics for Engineering & Science        | 4            |
|  | MATH 2513, Discrete Mathematics                                |   | Majors (Core II)  |              |
|  | C S 2413, Data Structures                                      | 3   | C S 2614, Computer Organization                             | 4            |
|  | ENGR 2002, Professional Development                            | 2   | #† Approved Elective: Natural Science (Core II)             | 3            |
|  | † Approved Elective: Social Science (Core III)                 | 3   | #Open Elective  | 4            |
|  | <b>TOTAL CREDIT HOURS</b>                                      | <b>15</b>                                     | <b>TOTAL CREDIT HOURS</b>                                   | <b>15-16</b> |
| <b>JUNIOR</b>  | P S C 1113, American Federal Government (Core III)             | 3   | @Open Elective  | 1-4          |
|  | MATH 3000-level or above and acceptable for credit for MATH    | 3   | MATH 3333, Linear Algebra                                   | 3            |
|  | Majors, or Complete a Minor                                    |   | C S 3053, Human Computer Interaction                        | 3            |
|  | C S 3113, Intro. to Operating Systems                          | 3   | C S 3323, Principles of Programming Languages               | 3            |
|  | C S 3203, Software Requirements & Specifications               | 3   | 1 of the following 3 courses:                               |              |
|  | C S 3823, Theory of Computation                                | 3   | ‡MATH 4753, Applied Statistical Methods, <b>or</b>          | 3            |
|  | #Open Elective   | 3   | ISE 3293, Applied Engineering Statistics, <b>or</b>         |              |
|  |  | ‡MATH 4743, Intro. to Mathematical Statistics |   |              |
|  | <b>TOTAL CREDIT HOURS</b>                                      | <b>18</b>                                     | <b>TOTAL CREDIT HOURS</b>                                   | <b>13-16</b> |
| <b>SENIOR</b>  | C S 4263, Software Engineering I                               | 3   | HIST 1483, U.S., 1492-1865, <b>or</b>                       | 3            |
|  | C S 4413, Algorithm Analysis                                   | 3   | 1493, U.S., 1865-Present (Core IV)                          |              |
|  | C S 4513, Database Management Systems                          | 3   | C S 4273, Software Engineering II (Capstone)                | 3            |
|  | ‡C S G4000/5000 Approved Elective, <b>or</b>                   | 3   | ‡C S G4000/5000 Approved Elective                           | 3            |
|  | ‡MATH 4073, Numerical Analysis                                 | 3   | ‡C S Approved Elective                                      | 3            |
|  | † Approved Elective: Western Civ. & Culture (Core IV)          | 3   | † Approved Elective: Non-Western Culture (Core IV)          | 3            |
|  | <b>TOTAL CREDIT HOURS</b>                                      | <b>15</b>                                     | <b>TOTAL CREDIT HOURS</b>                                   | <b>15</b>    |
| <b>Students are eligible for graduate status upon graduation with the Bachelor of Science in Computer Science.</b> |  |   |   |              |
| <b>FIFTH YEAR</b>  | ▲ ‡ G5000-level Approved Elective                              | 3   | ▲ ‡ G5000-level Approved Elective                           | 3            |
|  | ▲ G5000-level Approved Elective                                | 3   | ◆ ▲ 5000-level C S Electives                                | 3-6          |
|  | ▲ ◆ G5000-level C S Elective                                   | 3   | C S 5990 or C S seminar course                              | 3            |
|  | <b>TOTAL CREDIT HOURS</b>                                      | <b>9</b>                                      | <b>TOTAL CREDIT HOURS</b>                                   | <b>9-12</b>  |

Students may enter the accelerated program based on the undergraduate degree pattern offered in the year they first enrolled in the Oklahoma State System of Higher Education or later.  
**NOTE:** Engineering transfer students may take ENGR 3511 in place of ENGR 1411.

- Courses designated as Core I, II, III, IV or Capstone are part of the General Education curriculum. Students must complete a minimum of 40 hours of General Education courses, chosen from the approved list.
- †To be chosen from the **University-Wide General Education Approved Course List**. Three of these 12 hours must be upper-division (3000-4000). See list in the Class Schedule.
- Students must successfully complete prerequisite courses (with a minimum C grade) before proceeding to the next course.
- Two college-level courses in a single foreign language are required; this may be satisfied by successful completion of 2 years in a single foreign language in high school. Students who must take foreign language at the University will have an additional 6-10 hours of coursework.
- #At least one of the Natural Science courses must be a non-Physics course. The number of credits in Core II natural science and open electives must be 14 credit hours or more. All science courses must be for science or engineering majors.
- ‡To be chosen from C S 4013, 4323, 4513, 4613, 4973 or any C S 5000-level course.
- ▲Another laboratory science Core II course may be substituted for PHYS 1311.
- ‡At least one of these three MATH courses must be completed.
- ‡ Students must choose the following for these four electives: one Theory elective; two Systems electives; and one Applications elective. No more than one of these courses may be at the 4000-level. Courses for the areas are from the approved list from the School of Computer Science.
- ◆No more than two enrollments (six hours) in 5970, "Graduate Seminar" courses are allowed.
- Honors College students may substitute C S 3980 for an approved C S elective.
- ◆Thesis option requires a total of 9 hours of 5000-level electives, which must include six hours of C S 5980. Non-thesis option requires a total of 12 hours of 5000-level electives.
- ◆MATH 1823, 2423, 2433, and 2443 sequence can be substituted for MATH 1914, 2924, and 2934.
- @The credits from 1321, 1323, and 1324 plus the open electives must add up to 5. Students are required to make B or better in CS 1323/1324/1321 or CS 2334 before they can enroll in any other CS course.

**COURSES IN COMPUTER SCIENCE (C S)**

**1321 Java for Programmers.** Prerequisite: MATH 1523 or equivalent or concurrent enrollment or placement into MATH 1743 or MATH 1823 or higher and departmental permission. Introduction to computer programming using the Java programming language for students who are already proficient in another programming language. Topics include: variables and constants, arithmetic and Boolean expressions, conditional statements, repetition, methods, arrays, linear and binary search, basic sorting algorithms, object-oriented programming, documentation, and testing. (F, Sp)

**1323 Introduction to Computer Programming for Programmers.** Prerequisite: MATH 1523 or concurrent enrollment or placement into MATH 1743 or MATH 1823 or higher and department permission. Introduction to the design and implementation of computer software with an emphasis on abstraction and program organization for students with some prior programming experience. Topics include: variables and constants, arithmetic and Boolean expressions, conditional statements, repetition, methods, arrays, linear and binary search, basic sorting algorithms, object-oriented programming, documentation, and testing. (F, Sp)

**1324 Introduction to Computer Programming for Non-Programmers.** Prerequisite: Math 1523 or concurrent enrollment or placement into Math 1743 or Math 1823 or higher and departmental permission. Introduction to the design and implementation of computer software with an emphasis on abstraction and program organization for students with no prior programming experience. Topics include: variables and constants, arithmetic and Boolean expressions, conditional statements, repetition, methods, arrays, linear and binary search, basic sorting algorithms, object-oriented programming, documentation, and testing. (F, Sp)

**2334 Programming Structures and Abstractions.** Prerequisite: C S 1323 or 1321 or 1324, and MATH 1523 or higher. The design and implementation of computer programs using disciplined methodologies. Use of several abstract data types. Software reuse through encapsulation, composition, aggregation, inheritance, polymorphism, and generics. Topics include recursion, GUI development, file processing, and unit testing. A program design tool will be used. Introduction to ethics in computer science, including philosophical ethics theories. Discussion of intellectual property rights and privacy. (F, Sp)

**2413 Data Structures.** Prerequisite: C S 2334 and MATH 1823 or 1914; and C S 2813 or MATH 2513, or concurrent enrollment in C S 2813 or MATH 2513. Representation, analysis and implementation of data structures and associated algorithms including: algorithm complexity, sorting algorithms, lists, stacks, queues, search trees (AVL, Red-Black, Splay, 2-3), Heaps, Graphs, and Hashing. Written communications required in some projects. Ethical issues and tools and techniques used in writing secure applications will also be discussed. The primary programming language is C++ with a debugging tool. (F, Sp)

**2614 Computer Organization.** Prerequisite: CS 2334. An introduction to the architecture, organization and design of uniprocessor-based computer systems. Topics include processor, control and memory design and organization, pipelining and vector processing, computer arithmetic, I/O organization, and computer systems security. (F, Sp)

**2813 Discrete Structures.** Prerequisite: CS 2334 and MATH 1823 or MATH 1914. Introduction to the theory of discrete structures useful in computer science. Topics include combinatorics, relations, functions, computational complexity, recurrences, and graph theory. (F, Sp)

**3053 Human Computer Interaction.** Prerequisite: C S 2413, and C S 2813 or Mathematics 2513. An introduction to human-computer interaction and graphical user interfaces. Topics include principles of human-computer interaction, human perceptual and cognitive abilities, user interface analysis and design, window systems, and social implications of computing. Current user interface programming tools will be described and used. Oral presentations are required for some assignments. (Sp)

**3113 Introduction to Operating Systems.** Prerequisite: C S 2413 and C S 2813 or MATH 2513, and C S 2614 or ECE 2214. An introduction to the major concepts and techniques of designing and implementing operating systems including: memory management, process management, information management, and computer security. Principles of performance evaluation. Class projects require the design and implementation of software systems. A UNIX family operating system will be used. (F)

**3203 Software Requirements and Specifications.** Prerequisite: C S 2413 and C S 2813 or MATH 2513. Students gain technical and professional skills by performing requirements engineering. Learn the tools, techniques, and methods for modeling software systems. Students practice written and oral communication skills and consider the impact of computing on individuals, organizations and society, and demonstrate their ability to engage in lifelong learning by gaining background in a domain outside of their own. (F)

**3323 Principles of Programming Languages.** Prerequisite: C S 2413, and C S 2813 or MATH 2513, and ENGL 3153 or BC 2813 or ENGR 2002 as a prerequisite or concurrent enrollment. An introduction to theoretical foundations and paradigms of programming languages. Topics include basic concepts such as lexical analysis, syntax analysis, type systems and semantics, some practical issues such as memory management and exception handling, and programming paradigms such as imperative programming, object-oriented programming, functional programming and scripting. (Sp)

**3823 Theory of Computation.** Prerequisite: CS 2413 and CS 2813 or MATH 2513 or CS 5005 or DSA 5005. Introduction to abstract machine theory and formal language theory. Topics include Turing machines, finite/pushdown automata, deterministic versus nondeterministic computations, context-free grammars, and mathematical properties of these systems. (F)

**G4013 Artificial Intelligence (Slashlisted with 5013).** Prerequisite: CS 2413 or CS 5005, and CS 2813 or CS 4005 or MATH 2513. Study of the methods of search, knowledge representation, heuristics, and other aspects of automating the solution of problems requiring intelligence. No student may earn credit for both 4013 and 5013. (Sp)

**4023 Introduction to Intelligent Robotics (Slashlisted with 5023).** Prerequisite: C S 2413, and C S 2813 or MATH 2513. History of intelligent robotics; functional models approach; reactive robots; ethology for robotics; architectures and methodologies; implementation; sensing; hybrid deliberative/reactive robotics; multi-robot systems; navigation; topological path planning; metric path planning; localization and mapping. No student may earn credit for both 4023 and 5023. (F)

**4033 Machine Learning. (Slashlisted with 5033).** Prerequisites: C S 2413, and C S 2813 or MATH 2513, and MATH 4753 or ISE 3293 or MATH 4743, and MATH 3333, and MATH 3113 or MATH 3413. Topics include decision trees, relational learning, neural networks, Bayesian learning, reinforcement learning, multiple-instance learning, feature selection, learning appropriate representations, clustering, and kernel methods. No student may earn credit for both 4033 and 5033. (F)

**4053 Computer Graphics (Slashlisted with 5053).** Prerequisite: C S 2413, and C S 2813 or MATH 2513, and MATH 3333. An introduction to computer graphics. Topics include coordinate systems, transformations, rendering in both two and three dimensions, and graphical programming. No student may earn credit for both 4053 and 5053. (F)

**4073 Computer Game Development.** Prerequisite: 3113, 4053, Mathematics 3333, and Physics 2514. Introduction to the process of developing, maintaining, enhancing, adapting, or refactoring a computer based game. Students will work in project teams using an existing game engine. A software development process will be used. Software development tools will be used. Students will practice oral and written communication skills. (Irreg.)

**4113 Operating Systems Theory (Slashlisted with 5113).** Prerequisite: 3113 and Mathematics 4753 or Industrial Engineering 3293 or Mathematics 4743 or Engineering 3293. Continuation of study from 3113. Advanced topics and examples and simulation techniques used in performance evaluation. No student may earn credit for both 4113 and 5113. (Sp)

**4133 Data Networks (Slashlisted with 5133).** Prerequisite: 3113 or permission of instructor. Comprehensive treatment of data networking principles including: layered protocol design and their functions, tools for performance analysis, multi-access communication, routing and flow control. No student may earn credit for both 4133 and 5133. (F)

**4263 Software Engineering I.** Prerequisite: CS 3203 or ENGL 3153 or BC 2813 or ENGR 2002, and Computer Science major or minor. Methods and tools for software specification, design, and documentation. Emphasis on architectural modularity, encapsulation of software objects, and software development processes such as design review, code inspection, and defect tracking. Students working in teams apply these ideas to design and document software products. Study of professional ethics and responsibility, and legal issues. No student may obtain credit for CS 4263 and CS 5213. (F)

**†G4273 Software Engineering II.** Prerequisite: C S 3053 and C S 4263 and CS major or CS minor. Methods and tools for software development, testing, and delivery. Emphasis on data abstraction and reusable components. Students working in teams implement a significant software product, including design documents, user's guide, and process reports, using methods and processes studied in Software Engineering I. Students will practice oral and written communication skills. Study of professional social issues and responsibilities. No student may obtain credit for CS 4273 and CS 5213. (Sp) [V]

**G4323 Compiler Construction.** Prerequisite: 2413 and 3823. Introduction to the theory and implementation of programming language compilers and interpreters. Class projects require the design of medium scale software systems. (Sp)

**G4413 Algorithm Analysis.** (Crosslisted with DSA 4413) Prerequisites: C S 2413 and C S 2813; or MATH 2513; or C S 5005. Design and analysis of algorithms and measurement of their complexity. This course introduces various algorithm design strategies: divide and conquer, greedy principle and dynamic programming to solve a variety of problems using algorithms of various types - deterministic and randomized, serial and parallel, centralized and decentralized, program based and circuit based. (F)

**4433 Computational Methods in Discrete Optimization (Slashlisted with 5433).** Prerequisite: MATH 3333 and MATH 4413 or concurrent enrollment in 4413. Linear programming: simplex method for LP problems, degeneracy and anticycling strategies, duality theory and complementary slackness conditions, revised simplex method, sensitivity analysis and simplex method for general LP problems. Network optimization: the transshipment problem, network simplex method, shortest path algorithms, the maximum flow problem, and the primal dual method. No student may earn credit for both 4433 and 5433. (F)

**G4513 Database Management Systems.** (Crosslisted with DSA 4513) Prerequisites: C S 2413 and C S 2813; or MATH 2513; or C S 5005. The design and implementation of a DBMS including data models, query languages, entity-relationship diagrams, functional dependencies, normalization, storage structures, access methods, query processing, security and transaction management, and applications. The impact of databases on individuals, organizations, and society, and legal and professional responsibilities including security and privacy will be discussed. A commercial DBMS is used. Students practice written communication skills. (F)

**G4613 Computer Architecture (Crosslisted with ECE 4613).** Prerequisite: C S 2614 or ECE 3223. Covers basic concepts of computer system design and communication between components, along with current and historical examples of computer architecture. (F, Sp)

**4743 Scientific Computing I (Slashlisted with 5743).** Prerequisite: MATH 3333. Interaction between applications, architectures, and algorithms. Review of linear algebra, serial, pipelined vector processors, cluster of processors. Measures of performance of parallel algorithms. Parallel algorithms for the solution of linear systems. No student may earn credit for both 4743 and 5743. (F)

**4823 Cryptography (Slashlisted with 5823).** Prerequisite: 3823 and 4413. Elementary number theory, time complexity for doing arithmetic, finite fields, RSA, discrete logarithm and Diffie-Hellman, zero-knowledge protocols and oblivious transfer. Basic elliptic curve cryptosystems, elliptic curve factorization and primality proving. No student may earn credit for both 4823 and 5823. (Sp)

**4973 Special Topics.** Prerequisite: 2413 and permission of instructor. May be repeated with change of subject matter; maximum credit nine hours. A special topics course necessitated by the rapidly changing nature of computer sciences. Topics offered under this number will be accepted as approved Computer Science electives for Computer Science majors. (Irreg.)

**COURSES IN MATHEMATICS (MATH)**

**1914 Differential and Integral Calculus I.** Prerequisite: satisfactory score on the math assessment. Duplicates three hours of MATH 1823 and one hour of MATH 2423. Limits and continuity, differentiation, applications of differentiation to optimization and curve sketching, integration, the fundamental theorem of calculus, the substitution rule, applications of integration to computation of areas and volumes. (F, Sp, Su) [I-M]

**2924 Differential and Integral Calculus II.** Prerequisite: 1914 with a grade of C or better. Duplicates two hours of 2423 and two hours of 2433. The natural logarithmic and exponential functions, indeterminate forms, techniques of integration, improper integrals, parametric curves and polar coordinates, infinite sequences and series, vectors in two and three dimensions. (F, Sp, Su) **2934 Differential and Integral Calculus III.** Prerequisite: 2924 with grade of C or better. Duplicates one hour of 2433 and three hours of 2443. Vectors and vector functions, functions of several variables, partial differentiation and gradients, multiple integration, line and surface integrals, Green-Stokes-Gauss theorems. (F,Sp,Su)

**†G3333 Linear Algebra I.** Prerequisite: MATH 2433 or MATH 2934 or permission of instructor. Systems of linear equations, determinants, finite dimensional vector spaces, linear transformations and matrices, characteristic values and vectors. (F, Sp, Su)

**G4073 Numerical Analysis.** Prerequisite: 3113 or 3413. Solution of linear and nonlinear equations, approximation of functions, numerical integration and differentiation, introduction to analysis of convergence and errors, pitfalls in automatic computation, one-step methods in the solutions of ordinary differential equations. (F)

**4743 Introduction to Mathematical Statistics (Slashlisted with 5743).** Prerequisite: 4733. Mathematical development of basic concepts in statistics: estimation, hypothesis testing, sampling from normal and other populations, regression, goodness-of-fit. No student may earn credit for both 4743 and 5743. (Sp)

**G4753 Applied Statistical Methods.** Prerequisite: MATH 2123 or MATH 2423 or MATH 2924 or permission of instructor. Estimation, hypothesis testing, analysis of variance, regression and correlation, goodness-of-fit, other topics as time permits. Emphasis on applications of statistical methods. (F, Sp, Su)