Computer Science

Department Mission

The mission of the Department of Computer Science consists of three interrelated components: (1) providing the highest quality instruction to the students; (2) conducting leading-edge research in computer science and engineering; and (3) providing leadership and service to our professional communities. Computer Science’s faculty and staff are committed to excellence and updating the program to meet the present and future needs of industry and the society.

Purpose and Goals

The Bachelor of Science in Computer Science Program is designed to:

1. Provide a high quality degree program in computer science that will prepare students for lifelong learning as they pursue professional careers in computer science and leadership roles in the society in which they serve.
2. Provide our students with a strong foundation, state-of-the-art techniques, methodologies, and tools to specify, design and develop computer-based solutions to complex systems problems.
3. Provide opportunities for faculty and students to contribute to the body of knowledge that serves the profession, by engaging in research, scholarly and other activities which support their interests and are in agreement with the goals and objectives of the College, and the University.
4. Prepare our students to communicate well, both orally and in writing, on moral and ethical development, in knowledge of the liberal arts, and on commitment to services to others.

Admission Requirements

Table 1. First-time Freshmen Requirements for Direct Admission to the Computer Science Program

<table>
<thead>
<tr>
<th>Academic Major</th>
<th>Meet PVAMU Admission Standards</th>
<th>High School GPA</th>
<th>SAT/ACT</th>
<th>High School Rank</th>
<th>THEA Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>Yes</td>
<td>3.00</td>
<td>New SAT: 950/18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Transfer Students Requirements for Direct Admission to the Computer Science Program

<table>
<thead>
<tr>
<th>Academic Major</th>
<th>Meet PVAMU Admission Standards</th>
<th>Transfer Grades</th>
<th>Transfer GPA (Math; Science and Engineering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>Yes</td>
<td>“C” or greater</td>
<td>2.50</td>
</tr>
</tbody>
</table>

These tables represent a summary of admission requirements. For more detailed requirements see the section in the catalog pertaining to the Roy G. Perry College of Engineering Admission.

Accreditation Status


Bachelor of Science in Computer Science Degree Program Requirements

<table>
<thead>
<tr>
<th>Core Curriculum</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Requirements</td>
<td></td>
</tr>
<tr>
<td>MATH 1124</td>
<td>Calculus with Analytic Geometry I</td>
</tr>
<tr>
<td>MATH 2024</td>
<td>Calculus with Analytic Geometry II</td>
</tr>
<tr>
<td>GNEG 1121 &amp; GNEG 2021</td>
<td>Engineering Lab II for Mathematics and Engr Lab III for Math</td>
</tr>
<tr>
<td>Major Requirements</td>
<td></td>
</tr>
<tr>
<td>COMP 1011</td>
<td>Intro to Basic Engr &amp; Comp Sci</td>
</tr>
<tr>
<td>COMP 1021</td>
<td>Introduction to Computer Science Lab</td>
</tr>
<tr>
<td>COMP 1211</td>
<td>Computer Science Lab I</td>
</tr>
<tr>
<td>COMP 1221</td>
<td>Computer Science Lab II</td>
</tr>
<tr>
<td>COMP 1223</td>
<td>Computer Science II</td>
</tr>
<tr>
<td>COMP 2013</td>
<td>Data Structures</td>
</tr>
<tr>
<td>COMP 2043</td>
<td>Digital Logic Circuits</td>
</tr>
<tr>
<td>COMP 2103</td>
<td>Discrete Structures</td>
</tr>
</tbody>
</table>
COMP 3043  Computer Organization 3
COMP 3053  Analysis of Algorithms 3
COMP 3063  Operating Systems 3
COMP 3223  Software Engineering 3
COMP 3953  Database Management 3
COMP 4001  Ethics and Social Issues in Computing 1
COMP 4072  Senior Design Project I 2
COMP 4082  Senior Design Project II 2
COMP 4113  Programming Languages 3
COMP 4123  Computer Networks 3
COMP 4143  Introduction to Parallel Computing 3
COMP 4233  Network Security 3

Computer Science Lower Level Electives  6

Computer Science Upper Level Electives  6

Natural Sciences Area Requirements  2

Select one of the following sequences:  6

Science Sequence 1
CHEM 1033  General Inorganic Chemistry
& CHEM 1011  and Inorganic Chemistry Laboratory I
CHEM 1043  General Inorganic Chemistry
& CHEM 1021  and Inorganic Chemistry Laboratory II
PHYS 2513  University Physics I
& PHYS 2511  and University Physics Lab I

Science Sequence 2
CHEM 1033  General Inorganic Chemistry
& CHEM 1011  and Inorganic Chemistry Laboratory I
PHYS 2513  University Physics I
& PHYS 2511  and University Physics Lab I
PHYS 2523  University Physics II
& PHYS 2521  and University Physics Lab II

Science Sequence 3
BIOL 1113  College Biology I
& BIOL 1111  and College Biology Laboratory
PHYS 2513  University Physics I
& PHYS 2511  and University Physics Lab I
PHYS 2523  University Physics II
& PHYS 2521  and University Physics Lab II

Math Area Requirements
MATH 3023  Probability and Statistics 3
MATH 3073  Linear Algebra 3

Total Hours 121

1 All Computer Science Core Curriculum requirements are shown in the suggested degree program. All Computer Science majors must take ENGL 1123, ENGL 1143, COMP 1213, MATH 1124, PHYS 2513, CHEM 1033 or BIOL 1113 (Please refer to the Science Sequence option in the Natural Science Area requirements section), as part of the University Core Curriculum. Also, please note that 3 hours of MATH 1124 counts toward the core curriculum and 1 hour counts toward the college requirements.

2 Students are required to take all courses in Sequence 1, or Sequence 2, or Sequence 3. The students meet the 12 hours Science requirement by taking 6 hours from the core curriculum and the remaining 6 hours from the Science Sequences. Please note that one 3 hour course and 3 - 1 hour lab courses will count in the 6 hours not included in the core curriculum.

Computer Science Suggested Electives

Lower Level Electives
COMP 2003  Introduction to Web Design and Multimedia 3
COMP 2023  Applications Development using C# 3
COMP 2133  Introduction to Information Security  3
COMP 2143  Introduction to Java  3

Upper Level Electives
COMP 3113  Object-Oriented Analysis and Design  3
COMP 3203  System Analysis and Design  3
COMP 3213  Graphics and Visual Computing  3
COMP 3333  Smart Device App Development  3
COMP 4063  Artificial Intelligence  3
COMP 4073  Special Topics  3
COMP 4153  Data Mining and Analytics  3
COMP 4243  Advanced Application Development  3
COMP 4843  Human-Computer Interaction  3
COMP 4963  Introduction to Service Computing  3
COMP 4993  Independent Study  1-3

Technical Electives through Five-Year BS/MS Degree Plan Option

Students may, upon approval to the Five-Year BS/MS Degree Plan Option (see Roy G. Perry College of Engineering Academic Programs and Degree Plans), apply up to six semester-credit hours of graduate courses toward technical electives requirements.

Eligibility to Take Upper Division College Courses

The Roy G. Perry College of Engineering requires an eligibility standard for the students to take upper division college courses. Students must have completed or be currently enrolled in all lower division (1000 and 2000 level) courses in English, mathematics, science, and engineering to be eligible to enroll in upper division (3000 or 4000 level) courses in the Roy G. Perry College of Engineering. Students in Computer Science Program must get a "C" or better in each of the Math, Science, English, and Computer Science courses to be eligible to enroll in upper division (3000 or 4000 level) courses in the College. Students transferring to the Roy G. Perry College of Engineering with 60 or more semester hours from another institution will be allowed a period of one semester to comply.

Requirements for Computer Science as a Minor Field

COMP 1211  Computer Science Lab I  1
COMP 1213  Computer Science I  3
COMP 1221  Computer Science Lab II  1
COMP 1223  Computer Science II  3
COMP 2013  Data Structures  3
COMP 2103  Discrete Structures  3
Three Upper-Division Computer Science Courses  9
MATH 1124  Calculus with Analytic Geometry I  4
MATH 2024  Calculus with Analytic Geometry II  4
Total Hours  31

Purpose and Goals

The Master's degree programs prepare graduate students for positions in industry and research. Master's degree graduates are also provided with a foundation for continuing their study at the doctoral level in Computer Science or Computer Information Systems.

The major objectives of the programs are to:

1. Address the critical shortage of professionals in Computer Science and Information Technology in Texas and the nation;
2. Provide an avenue for computer professionals in industry to upgrade their professional skills; and
3. Prepare graduates to pursue the terminal degree in Computer Science and Computer Information Systems.

Special Student Admission

Applicants who wish to take graduate courses but who do not meet the minimum GPA for admission as degree, provisional, or non-degree status may apply for special student status admission to the University in order to enroll in the required computer science background courses. These students must have been highly recommended based upon evidence of scholarly potential.
A student with a bachelor's degree in a discipline other than computer science must possess a computer science background equivalent to the following PVAMU courses before being admitted to:

**MS in Computer Science Program:**

- COMP 2013 Data Structures 3
- COMP 2103 Discrete Structures 3
- MATH 2024 Calculus with Analytic Geometry II 4
- COMP 3043 Computer Organization 3
- COMP 3053 Analysis of Algorithms 3

**MS in Computer Information System Program:**

- COMP 1224 Computer Science and Laboratory II 4
- ECON 2113 Principles of Microeconomics 3
- MATH 1124 Calculus with Analytic Geometry I 4
- MATH 3023 Probability and Statistics 3
- One Business Elective 3

**Master of Science in Computer Information Systems Degree Program Requirements**

**Computer Information Systems Core Requirements**

- CINS 5033 Database Management Systems 3
- CINS 5043 Data Communications and Computer Networks 3
- CINS 5063 Data Structures and Algorithms 3
- CINS 5073 Information Technology 3
- CINS 5183 Software Engineering 3
- CINS 5193 Enterprise Information Systems 3

**Concentration (select one from below):** 18

- **Thesis Concentration:**
  - CINS 5906 Masters Thesis
  - Electives (Select 12 hours from the approved CINS Electives)

- **Non-Thesis Concentration**
  - CINS 5913 Masters Project
  - or CINS 5383 Software Project Management
  - Electives (Select 15 hours from the approved CINS Electives)

**Total Hours** 36

**General CINS Electives**

- CINS 5103 Decision Support Systems 3
- CINS 5153 Object-Oriented Analysis and Design 3
- CINS 5173 Information Storage and Retrieval 3
- CINS 5203 Web Application Dev I 3
- CINS 5243 Web Application Development II 3
- CINS 5303 E-Commerce 3
- CINS 5313 Information Assurance 3
- CINS 5323 Multimedia Applications 3
- CINS 5343 Mobile & Wireless Info Systems 3
- CINS 5893 Applied Research 3
- CINS 5983 Special Topics in Computer Information Systems (Special Topics) 3
- CINS 5993 Independent Study 3

**Master of Science in Computer Science Degree Program Requirements**

**Computer Science Core Requirements**

- COMP 5003 Research Methods and Graduate Seminar 3
### Computer Science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 5113</td>
<td>Fundamentals and Concepts of Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5123</td>
<td>Advanced Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5133</td>
<td>Advanced Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5143</td>
<td>Advanced Database Management System</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5153</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5423</td>
<td>Software Engineering Processes</td>
<td>3</td>
</tr>
</tbody>
</table>

**Concentration (Select one from below):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 5906</td>
<td>Masters Thesis</td>
<td>15</td>
</tr>
</tbody>
</table>

**Electives (Select 9 hours from the approved Computer Science Electives)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 5213</td>
<td>Advanced Data Communications and Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5233</td>
<td>Distributed Computing and Parallel Processing</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5253</td>
<td>Theory of Computation</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5263</td>
<td>Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5273</td>
<td>Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5283</td>
<td>Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5323</td>
<td>Computer and Network Security</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5413</td>
<td>Object-Oriented Analysis and Design Methodology</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5433</td>
<td>Software Project Planning and Management</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5443</td>
<td>Advanced Software Quality Assurance</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5463</td>
<td>Human Computer Interaction and Interface Design</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5893</td>
<td>Applied Research</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5983</td>
<td>Special Topics in Computer Science (Special Topics)</td>
<td>3</td>
</tr>
<tr>
<td>COMP 5993</td>
<td>Independent Study</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Hours**

36

### General Computer Science Electives

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<tr>
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<th>Hours</th>
</tr>
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<td>Distributed Computing and Parallel Processing</td>
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<td>3</td>
</tr>
<tr>
<td>COMP 5993</td>
<td>Independent Study</td>
<td>3</td>
</tr>
</tbody>
</table>

### Professional and Honor Societies

The Department sponsors a certified student chapter of the Association for Computing Machinery. Membership (local and national) is open to all fulltime Computer Science majors. The department also sponsors Upsilon Phi Epsilon (Computer Science Honor Society) for all Computer Science majors with a GPA of 3.0 or above. Any student having completed 64 semester hours of course work (18 hours of core computer science courses) is eligible for consideration by the society.

### Courses

**COMP 1003 Digital Communication: 3 semester hours.**

Efficient communication in the digital world, including multi-media editing, web page/site design, publishing on the internet, and cloud computing. Social and ethical responsibility of using social media, surfing the internet, and information security. Fundamentals of Excel spreadsheets and MS Access together pertinent information analyzed, evaluate, interpret, display data, and draw conclusion. Team projects using Sharepoint and group presentation.

**COMP 1011 Intro to Basic Engr & Comp Sci: 1 semester hour.**

Students will become aware of the various disciplines of engineering, computer science and technology, ethical and professional responsibilities in these fields, creativity and design.

Prerequisites: COMP 1021 (http://catalog.pvamu.edu/search/?P=COMP%201021) (may be taken concurrently).

**COMP 1013 Introduction to Computer Science: 3 semester hours.**

Fundamentals of computer science and programming to include algorithm definition, concepts, semantics and logic, fundamental data types (character, integer, and floating-point) and their binary representations and limits, arithmetic and logical operators and precedence, program structure and flow, branching and looping, functions and parameters, and basic input and output methods, emphasizing modular design and implementation of an object-oriented language such as C++.
COMP 1021 Introduction to Computer Science Lab: 1 semester hour.
This lab component will cover the overview of the current job opportunities and some hands-on exercises to understand the current topics. Prerequisites: COMP 1011 (may be taken concurrently).

COMP 1211 Computer Science Lab I: 1 semester hour.
A laboratory course in programming for computer science utilizing the concepts introduced in COMP 1213, including language concepts of input/output, constants, data types, control structures, loops, functions, enumerated data types, arrays and strings structures, exception handling. Prerequisites: COMP 1221 (may be taken concurrently), or MATH 1124 (may be taken concurrently) or MATH 1123 (may be taken concurrently).

COMP 1212 Computer Science Lab II: 1 semester hour.
A laboratory course in programming for computer science utilizing the concepts introduced in COMP 1213, including language concepts of input/output, constants, data types, control structures, loops, functions, enumerated data types, arrays and strings structures, exception handling. Prerequisites: COMP 1221 (may be taken concurrently), or MATH 1124 (may be taken concurrently).

COMP 1221 Computer Science I: 3 semester hours.
Introduction to and practice of modern problem solving and programming methods. Special emphasis is placed on top-down modular design and implementation of robust and easily maintainable programs in a high-level, object-oriented language such as C++ to include external files, control structures, loops, scope, functions, output formatting, inline functions and function templates, enumerated data types, arrays, structures, exception handling. Prerequisites: MATH 1115 or MATH 1123 (may be taken concurrently) or MATH 1124 (may be taken concurrently). Co-requisite: COMP 1211.

COMP 1224 Computer Science and Laboratory II: 4 semester hours.
Continuation of COMP 1214 with continued emphasis on program development techniques, array based lists, pointers, basic linked lists, stacks and queues. Prerequisites: COMP 1213 (may be taken concurrently) and COMP 1211 (may be taken concurrently). Co-requisite: MATH 1124.

COMP 1223 Computer Science II: 3 semester hours.
The role of internet and as a tool in business; design and development of simple internet applications using HTML; basics of scripting languages; development of home pages incorporating graphics, and multimedia. Prerequisites: COMP 1213 (may be taken concurrently) or MATH 1124 (may be taken concurrently).

COMP 2003 Introduction to Web Design and Multimedia: 3 semester hours.
Fundamental data structures; the implementation and application of binary files, stacks, queues, recursion, advanced linked lists, trees, graphs, data compression, heap, priority queue, and sorting techniques. Prerequisites: COMP 1224 (may be taken concurrently) and COMP 1221 (may be taken concurrently).

COMP 2013 Applications Development using C#: 3 semester hours.
Introduction to developing Windows based applications using the Visual Studio C# language. Students will learn how to develop software for several types of (fun) applications using interactive forms, multimedia, graphics, images, Web services, streaming video, etc. Basics of developing simple games, incorporating web services such as Mapping, weather, You-tube, stock quotes, etc. will also be covered. Open to all majors. Prerequisites: COMP 1013 (may be taken concurrently) or COMP 1213 (may be taken concurrently).
**COMP 2103 Discrete Structures: 3 semester hours.**
A bridge course between data structures/discrete mathematics and analysis of algorithms, to include reviews of functions and relations, basic combinatorics (set operations, counting, combinations, and permutations) and introductions to prepositional and predicate logic, discrete probability theory, recursive definitions, computational complexity, and proof techniques including mathematical induction. The concepts are illustrated by applications involving graphs, trees, networks and related algorithms.
Prerequisites: COMP 2013 or COMP 1224 or COMP 1223 and COMP 1211.

**COMP 2133 Introduction to Information Security: 3 semester hours.**
Expose students to the concept of network security and make them aware of related information security and privacy problems. Topics in network security includes malware, social engineering attacks, Web application attacks, wireless security, access control, authentication, basic cryptography, and security in social medial and cloud computing. Various attack demonstrations and animations will be utilized. This course can be used as low-level CS elective.
Prerequisites: COMP 1224.

**COMP 2143 Introduction to Java: 3 semester hours.**
An introduction to the Java Programming language. Includes coverage of Java Development Kit (JKD), applications, creating applets for enhancing web pages, and an introduction to the object model, and object oriented programming. Prerequisites: Proficiency in at least one programming language. Can be used as a computer science lower level elective.

**COMP 3033 Digital Logic Circuits: 3 semester hours.**
The design and implementation of digital logic circuits. Combinational and sequential circuit analysis. Digital circuit design optimization methods using random logic gates, multiplexers, decoders, registers, counters, and programmable logic arrays.
Prerequisites: COMP 2033.

**COMP 3043 Computer Organization: 3 semester hours.**
The study of a computer as a series of levels, each one built on its predecessor. Digital logic level, the microprogramming level, the conventional machine level, the operating systems level, and the assembly language level.
Prerequisites: COMP 2043.

**COMP 3053 Analysis of Algorithms: 3 semester hours.**
Introduction to algorithm design and analysis, computational complexity, and NP-completeness theory, emphasizing design, appropriate algorithms and data structures to solve a given problem efficiently, including divide- and-conquer techniques, greedy methods, and dynamic programming.
Prerequisites: COMP 2013  and COMP 2103.

**COMP 3063 Operating Systems: 3 semester hours.**
Basic functions of operating systems including device management, multi-programming, job management, memory management, and input/output processing.
Prerequisites: COMP 2013  or ELEG 4393 and COMP 3043.

**COMP 3113 Object-Oriented Analysis and Design: 3 semester hours.**
Application and benefits of the object-oriented software process model with special consideration to concepts, models, notations, and methods to effectively and efficiently design and implement complex software applications using a practical, state-of-the-art object-oriented method, covering concepts intrinsic to object-oriented technology such as data abstraction, encapsulation, inheritance and polymorphism. State-of-the-art design and implementation tools, such as the unified modeling language (UML) and a high-level object-oriented language such as C++ will be used to illustrate these concepts.
Prerequisites: COMP 2013.

**COMP 3203 System Analysis and Design: 3 semester hours.**
Studying analytical models of system design with emphasis on evaluating system for efficiency, maximum utilization and appropriateness, and on structuring and designing systems.
Prerequisites: COMP 1224 or COMP 1223 and COMP 1211.

**COMP 3213 Graphics and Visual Computing: 3 semester hours.**
Principles of interactive computer graphics; Topics include fundamental techniques in graphics, graphic systems, graphic communication, geometric modeling, rendering, computer animation, visualization and virtual reality and other recent developments in computer graphics.
Prerequisites: COMP 2013.

**COMP 3223 Software Engineering: 3 semester hours.**
Formal software development, including the software life-cycle, modular and top-down design, validation and verification, and maintainable systems.
Prerequisites: COMP 2013.
**COMP 3333 Smart Device App Development: 3 semester hours.**
Introduction to app development for smart devices, specifically for Apple iOS or Google Android devices. Differences between smart devices and traditional desktop computer systems will be examined. Various app development environments will be covered, including Xcode and programming language Objective-C for iOS, and Eclipse for Android.
Prerequisites: COMP 2013 ([link](http://catalog.pvamu.edu/search/?P=COMP%202013)).

**COMP 3953 Database Management: 3 semester hours.**
File structures and access methods, database modeling design and user interface, components of database management systems. Information storage and retrieval, query languages, high-level language interfaces with database systems.

**COMP 4001 Ethics and Social Issues in Computing: 1 semester hour.**
Social and ethical implications of computing. Topics include history of computing, social context of computing, methods and tools of analysis, professional and ethical responsibilities, risks and liabilities of computer-based systems, intellectual property, privacy and civil liberties.

**COMP 4053 Parallel Algorithm Design: 3 semester hours.**
Hardware organization of vector, array, and parallel processors for high performance computations. Study of interconnection networks and parallel processing. Automatic vectorization and parallelization of scalar programs. Implementation of parallel algorithms for scientific applications.
Prerequisites: COMP 3043 ([link](http://catalog.pvamu.edu/search/?P=COMP%203043)) and COMP 3053 ([link](http://catalog.pvamu.edu/search/?P=COMP%203053)).

**COMP 4063 Artificial Intelligence: 3 semester hours.**
Introduction to artificial intelligence and expert systems to include heuristic search methods, first-order logic, forward and backward inference, knowledge representation, machine learning, and neural networks.
Prerequisites: COMP 2013 ([link](http://catalog.pvamu.edu/search/?P=COMP%202013)) and MATH 3023 ([link](http://catalog.pvamu.edu/search/?P=MATH%203023)).

**COMP 4072 Senior Design Project I: 2 semester hours.**
A first of a two-part senior design course for computer science majors. Students will study computer systems design working as a design-team member, conceptual design methodology, design evaluations, project planning and management techniques, design optimization, systems manufacturing, cost considerations with an emphasis on students' activities as design professionals.
Prerequisites: COMP 3223 ([link](http://catalog.pvamu.edu/search/?P=COMP%203223)) (may be taken concurrently) and COMP 3063 ([link](http://catalog.pvamu.edu/search/?P=COMP%203063)) (may be taken concurrently).
Co-requisite: COMP 4001 ([link](http://catalog.pvamu.edu/search/?P=COMP%204001)).

**COMP 4073 Special Topics: 3 semester hours.**
Studying selected current and emerging topics in Computer Science. Courses may be repeated for credit when topics vary.

**COMP 4082 Senior Design Project II: 2 semester hours.**
A continuation of COMP 4072 ([link](http://catalog.pvamu.edu/search/?P=COMP%204072)) giving students the opportunities to complete a design project, make formal presentation, research, proposal writing, patents, and literature searches.
Prerequisites: COMP 4072 ([link](http://catalog.pvamu.edu/search/?P=COMP%204072)).

**COMP 4113 Programming Languages: 3 semester hours.**
Overview of programming languages, syntactic and semantic specification, virtual machines and fundamental issues in language design, analyzing of the imperative, object-oriented, functional, and declarative language paradigms. Introduction to formal grammars, including Backus-Naur notation studying the formal theory behind the design of a programming languages. Several programming languages will be analyzed.

**COMP 4123 Computer Networks: 3 semester hours.**
Introduction to the networking of computer systems to include the study of local area (LAN) and wide area (WAN) networks, data transmission, communications software, the architecture of networks, and network communication protocols.
Prerequisites: COMP 3063 ([link](http://catalog.pvamu.edu/search/?P=COMP%203063)).

**COMP 4133 Formal Languages and Automata: 3 semester hours.**
Introduction to formal grammars, including Backus-Naur notation studying the formal theory behind the design of a computer language. The corresponding types of automata that will serve as recognizers and generators for a language will be described.
Prerequisites: COMP 2103 ([link](http://catalog.pvamu.edu/search/?P=COMP%202103)).

**COMP 4143 Introduction to Parallel Computing: 3 semester hours.**
Students will study modern parallel computer architectures and the major parallel programming models in both shared and distributed systems. Topics include parallelism, concurrency, partition, divide-and-conquer, synchronization, load balancing, parallel algorithm design, implementation, and debugging.
Prerequisites: COMP 2013 ([link](http://catalog.pvamu.edu/search/?P=COMP%202013)) and COMP 2103 ([link](http://catalog.pvamu.edu/search/?P=COMP%202103)).
COMP 4153 Data Mining and Analytics: 3 semester hours.
Topics cover fundamental data mining and analytical algorithms and paradigms, including supervised learning, unsupervised learning, frequent pattern mining, link analysis, performance improvement through data interaction, etc. Focus on implementation and data visualization using modern programming languages in the knowledge discovery process. Latest concepts such as big data and social media are also discussed. Prerequisites: MATH 3023 and MATH 3073.

COMP 4233 Network Security: 3 semester hours.
Address the fundamentals of network security, including compliance and operational security; threats and vulnerabilities; application, data and host security; access control and identity management; and cryptography. Topics includes psychological approaches to social engineering attacks, Web application attacks, penetration testing, data loss prevention, cloud computing security, and application programming development security. Prerequisites: COMP 4123.

COMP 4243 Advanced Application Development: 3 semester hours.
Topics cover web server configuration, advanced client side scripting, server side programming, database server management, and application development on mobile platforms. Focus on server-side script languages, database design and operation, and advanced web design skills on both computer and smart mobile phones. Prerequisites: COMP 3953.

COMP 4843 Human-Computer Interaction: 3 semester hours.
Focuses on the dynamics of human-computer interaction (HCI). Provides a broad overview of HCI as a sub-area of computer science and explores user-centered design approaches in information systems applications. Addresses the user interface and software design strategies, user experience levels, interaction styles, usability engineering, and collaborative systems technology. Students will perform formal software evaluations and usability tests. Prerequisites: COMP 3223.

COMP 4953 Data Base Management: 3 semester hours.
File structures and access methods, database modeling design and user interface, components of database management systems. Information storage and retrieval, query languages, high-level language interfaces with database systems. Prerequisites: COMP 2013.

COMP 4963 Introduction to Service Computing: 3 semester hours.
Introduces core techniques of service computing, including service-oriented architecture, the roles of application builders, service specifications, workflow modeling, and specifications, service providers and services brokers, dynamic service discovery and basic ontology, understand major paradigms of computing. Prerequisites: COMP 4953.

COMP 5003 Research Methods and Graduate Seminar: 3 semester hours.
Series of lectures given by faculty and by visiting computer and information scientists and information technologists.

COMP 5113 Fundamentals and Concepts of Programming Languages: 3 semester hours.
Study of the principles that form the basis of programming language design. Research topics in high-level languages including data abstraction, parameterization, scoping, generics, exception handling, parallelism, and concurrency. Additional topics include alternative language designs (imperative, functional, descriptive, object-oriented, and data flow designs) and an overview of interfacing with support environments. Prerequisites: COMP 4113.

COMP 5123 Advanced Computer Architecture: 3 semester hours.
New technological developments, including details of multiprocessor systems and specialized machines. The main focus is on the quantitative analysis and cost-performance tradeoffs in instruction set, pipeline, and memory design. Descriptions of real systems and their performance data are also given. Topics covered include quantitative performance measures, instruction set design, pipelining, vector processing, memory organization, input/output methods, and an introduction to parallel processing. Prerequisites: COMP 3043.

COMP 5133 Advanced Operating Systems: 3 semester hours.
Theoretical and practical aspects of operating systems, including an overview of system software, time-sharing and multiprogramming operating systems, network operating systems and the Internet, virtual memory management, inter-process communication and synchronization, and case studies. Prerequisites: COMP 3063.
COMP 5143 Advanced Database Management System: 3 semester hours.
Topics related to database design and data management in a database environment, including data normalization, functional dependencies, database design, query language design, implementation constraints, data integrity and security, and distributed data processing. The emphasis is on the concepts and structures necessary to design and implement a database management system. Selected advanced topics such as distributed databases, object-oriented databases, real-time databases, and multimedia databases will be discussed. Because of the many advances in information technology and the database development techniques, new business needs and opportunities are constantly emerging and, with them, the need to manage new technologies and applications effectively. This course explores these new application areas and the management approaches needed to make them successful.
Prerequisites: CINS 5033 (http://catalog.pvamu.edu/search/?P=CINS%205033).

COMP 5153 Design and Analysis of Algorithms: 3 semester hours.
Introduction to algorithm design and analysis, computational complexity, and NP-completeness theory. The course emphasizes how to design and choose appropriate algorithms and data structures to solve a given problem efficiently. Design methods covered include divide-and-conquer techniques, greedy methods, and dynamic programming. Problem domains covered include string matching, polynomials and matrices, graph theory, optimal trees, and NP-hard problems.
Prerequisites: COMP 3053 (http://catalog.pvamu.edu/search/?P=COMP%203053).

COMP 5183 Software Engineering: 3 semester hours.
Topics related to specifying software requirements and an overview of analysis and design techniques that can be used to structure applications. Topics in software requirements include interacting with end-users to determine needs and expectations, identifying functional requirements, and identifying performance requirements. Analysis techniques include prototyping, modeling, and simulation. Design topics include the system lifecycle, hardware and software trade-offs, subsystem definition and design, abstraction, information hiding, modularity, and reuse.

COMP 5193 Mobile Device App Design and Development: 3 semester hours.
Introduction to app development for mobile devices, specifically for Apple iOS or Google Android devices. Various app development environments will be covered, including Xcode and programming language Objective-C for iOS, or Eclipse for Android. App design strategy will be discussed.
Prerequisites: COMP 2013 (http://catalog.pvamu.edu/search/?P=COMP%202013).

COMP 5213 Advanced Data Communications and Computer Networks: 3 semester hours.
Topics related to the development of client-server based applications, including two-tier and multi-tier client-server concepts and programming, concurrency issues in the design of client and server programs, trade-offs of different architectures, the use of remote procedure calls, and broadcasting and multicasting.
Prerequisites: COMP 4123 (http://catalog.pvamu.edu/search/?P=COMP%204123) or CINS 5043 (http://catalog.pvamu.edu/search/?P=CINS%205043).

COMP 5233 Distributed Computing and Parallel Processing: 3 semester hours.
Comprehensive introduction to the field of parallel and distributed computing systems, including algorithms, architectures, networks, systems, theory, and applications. Distributed parallel computation models, and the design and analysis of parallel algorithms will be emphasized.
Prerequisites: COMP 5133 (http://catalog.pvamu.edu/search/?P=COMP%205133).

COMP 5253 Theory of Computation: 3 semester hours.
Models of computation, complexity theory, intractable problems, complete problems, recursive function theory, incompleteness, formal theory of program semantics and correctness, and logics of programs.
Prerequisites: COMP 3053 (http://catalog.pvamu.edu/search/?P=COMP%203053) or COMP 5153 (http://catalog.pvamu.edu/search/?P=COMP%205153).

COMP 5263 Computer Graphics: 3 semester hours.
Topics in computer graphics and geometric modeling, including B-spline curves and surfaces, solid modeling, radiosity, morphing, animation, simulation, subdivision, fractals, wavelets, and other selected topics.

COMP 5273 Data Mining: 3 semester hours.
Data Mining Studies algorithms, paradigms to find patterns and regularities in databases, perform prediction and forecasting, and improve their performance through data interaction. The knowledge discovery process includes data selection, cleaning, coding, and visualization. Data warehousing is also discussed.
Prerequisites: COMP 4953 (http://catalog.pvamu.edu/search/?P=COMP%204953) or CINS 5033 (http://catalog.pvamu.edu/search/?P=CINS%205033).

COMP 5283 Machine Learning: 3 semester hours.
Study machine learning principles and techniques including supervised and unsupervised learning, learning method analysis, theoretical and empirical evaluation. Topics include decision tree, neural networks, Bayesian learning, instance-based learning, support vector machine, etc. and their implementation.
Prerequisites: COMP 2013 (http://catalog.pvamu.edu/search/?P=COMP%202013) and MATH 3023 (http://catalog.pvamu.edu/search/?P=MATH%203023).

COMP 5323 Computer and Network Security: 3 semester hours.
Survey of various computer attacks, viruses, malware, and operating system vulnerabilities and safeguards. Emphasis will be put on defense techniques and skills. A study of problems related to data communication and networking security; databases security; authorization mechanisms for systems with shared resources; cryptography and applications.
Prerequisites: (CINS 5043 (http://catalog.pvamu.edu/search/?P=CINS%205043) or COMP 4123 (http://catalog.pvamu.edu/search/?P=COMP%204123)) and (CINS 5063 (http://catalog.pvamu.edu/search/?P=CINS%205063) or COMP 3053 (http://catalog.pvamu.edu/search/?P=COMP%203053)).
COMP 5413 Object-Oriented Analysis and Design Methodology: 3 semester hours.
Design and analysis methods for developing high-quality object-oriented systems. Topics include object-oriented classes, attributes, methods, and relations to other classes, objects, classifications and inheritance, encapsulation, polymorphism, and object-oriented analysis, design, and programming. Prerequisites: COMP 2013 (http://catalog.pvamu.edu/search/?P=COMP%202013) or CINS 5063 (http://catalog.pvamu.edu/search/?P=CINS%205063).

COMP 5423 Software Engineering Processes: 3 semester hours.
Engineering of complex systems that have a strong software component. Topics include deriving and allocating requirements, system and software architectures, systems analysis and design, integration, interface management, configuration management, quality, verification and validation, reliability, and risk. Prerequisites: COMP 2013 (http://catalog.pvamu.edu/search/?P=COMP%202013) or CINS 5063 (http://catalog.pvamu.edu/search/?P=CINS%205063).

COMP 5433 Software Project Planning and Management: 3 semester hours.
Methods for successful management of a software development project. This includes planning, scheduling, tracking, cost and size estimating, risk management, quality engineering, and process improvement. The course is centered on the concept of a software engineering process and includes discussion of life-cycle models for software development. Prerequisites: COMP 5423 (http://catalog.pvamu.edu/search/?P=COMP%205423).

COMP 5443 Advanced Software Quality Assurance: 3 semester hours.
The relationship of software testing to quality is examined with an emphasis on testing techniques and the role of testing in the validation of system requirements. Topics include module and unit testing, integration, code inspection, peer reviews, verification and validation, statistical testing methods, preventing and detecting errors, selecting and implementing project metrics, and defining test plans and strategies that assure conformance to system requirements. Testing principles, formal models of testing, and performance monitoring and measurement are also examined. Prerequisites: COMP 5423 (http://catalog.pvamu.edu/search/?P=COMP%205423).

COMP 5463 Human Computer Interaction and Interface Design: 3 semester hours.
A research-oriented course featuring in-depth analyses of selected current topics with an emphasis on problems related to computer systems, artificial intelligence, and human-computer interaction and interface design. Prerequisites: COMP 5423 (http://catalog.pvamu.edu/search/?P=COMP%205423).

COMP 5893 Applied Research: 3 semester hours.
A realistic experience in Computer Science to enhance the student's professional abilities. Students work on significant projects with industry firms or governmental agencies involving decision-making responsibility. Course requires oral and written report.

COMP 5906 Masters Thesis: 6 semester hours.
A candidate for the Master of Science in Computer Science with thesis option is required to perform a study, a design or investigation, under the direction of a faculty advisory committee. A written thesis is required to be presented, defended orally and submitted to the faculty advisory committee for approval.

COMP 5913 Masters Project: 3 semester hours.
A candidate for the Master of Science in Computer Science with project option is required to perform a study, design, or investigation, under the direction of a graduate faculty advisor. An oral presentation and a written report are required. Prerequisite: candidacy for the Non-Thesis option of the Master of Science in Computer Science.

COMP 5983 Special Topics in Computer Science: 3 semester hours.
Exposure to new and emerging concepts and technologies.

COMP 5993 Independent Study: 3 semester hours.
Individual studies in advanced computer science and technology.