COMPUTER SCIENCE (CS)

CS-104  Introduction to Problem Solving and Software Development  Credits: 3
Term Offered: All Terms
Course Type(s): TL
Introduces a broad overview of problem solving, computing topics, and fundamental concepts and methodologies of software development designed to provide students with awareness of the computing field's many aspects. Topics include fundamentals of computer architecture, operating systems, applications, problem-solving. It emphasizes the main phases of the software development lifecycle, such as requirements, design, implementation, testing, project planning. Also, it stresses the difference between the software product and process. Introduces social and ethical issues related to computing and explores the local and global impact of computing on individuals, organizations and society. It also gives students their initial exposure to group project work.

CS-175  Introduction to Computer Science I  Credits: 3
Prerequisite(s): CS-104
Co-requisite(s): CS-175L
Term Offered: All Terms
Course Type(s): None
Introductions to the basic concepts of program development in a modern object-oriented language; problem-solving methods and algorithm development; basic primitive and object data types; language syntax; style and documentation; and coding and testing of programs

CS-175L  Introduction to Computer Science I lab  Credits: 1
Prerequisite(s): CS-104
Co-requisite(s): CS-175
Term Offered: All Terms
Course Type(s): None
Introductions to the basic concepts of programming and program development in a modern Software Development Environment with debugger and source code control.

CS-176  Introduction to Computer Science II  Credits: 3
Prerequisite(s): CS-175 and CS-175L, both passed with a grade of C or higher
Co-requisite(s): CS-176L
Term Offered: All Terms
Course Type(s): None
Continuation in depth and breadth of problem solving and algorithm development, using the same modern object-oriented language as in CS-175. More advanced object-oriented design. Introduction to polymorphism, inheritance, and interfaces.

CS-176L  Introduction to Computer Science II Lab  Credits: 1
Prerequisite(s): CS-175 and CS-175L, both passed with a grade of C or higher
Co-requisite(s): CS-176
Term Offered: All Terms
Course Type(s): None
Introduction to advanced concepts of programming and program development in a modern Software Development Environment with debugger and source code control.

CS-199  Independent Study in Computer Science  Credits: 1-3
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

CS-201  Introduction to Computer Programming for Data Science  Credits: 1
Prerequisite(s): IT-100 or IT-102 or IT-150 or CS-104
Term Offered: Spring Term
Course Type(s): None
This course introduces the most important data structures available in R and their practical application. Methodologies to import data from external sources (files, databases, on-line resources), to manipulate and transform data, and to save/export data to data repositories are described. The course also describes how to compute descriptive statistics and how to build chart for effective data visualization tasks. The students will become familiar in using some R data manipulation and visualization libraries.

CS-202  Discrete Mathematics and Applications  Credits: 4
Prerequisite(s): CS-175 and MA-109
Term Offered: All Terms
Course Type(s): None
Covers the basic concepts, methods, structures, and models from discrete mathematics used throughout computer science. Topics addresses include: logic and mathematical reasoning, functions, sets, summations, asymptotic notation, algorithms and complexity, number theory, cryptography, matrix algebra, induction and recursion, counting techniques, combinatorial objects, discrete structures, discrete probability theory, relations, and graph theory and graph algorithms.

CS-205  Data Structures and Algorithms  Credits: 3
Prerequisite(s): MA-130, CS-176, and CS-176L, all passed with a grade of C or higher
Co-requisite(s): CS-205L
Term Offered: All Terms
Course Type(s): None
Introduction to the design, implementation, and use of fundamental data structures (lists, stacks, queues, trees); extensions of these structures and associated algorithms; informal complexity analysis.

CS-205L  Data Structures and Algorithms Lab  Credits: 1
Prerequisite(s): MA-130, CS-176, and CS-176L, all passed with a grade of C or higher
Co-requisite(s): CS-205
Term Offered: All Terms
Course Type(s): None
Introductions to the basic concepts of programming and program development in a modern Software Development Environment with debugger and source code control.

CS-250  Android Application Development  Credits: 3
Prerequisite(s): CS-176 and CS-176L
Term Offered: Spring Term
Course Type(s): None
This course will teach students software methodologies for Android App Development. This will include Android Development Studio, Kotlin programming language, and interfaces to external services required to develop simple to moderately complex Android mobile apps. Also listed as SE-250.

CS-286  Computer Architecture I  Credits: 3
Prerequisite(s): CS-176 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
CS-298 Special Topics in Computer Science (200 Level)  Credits: 1-3
Term Offered: Spring Term
Course Type(s): None
An intensive study of a particular subject or problem in computer science to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.

CS-299 Independent Study in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

CS-305 Advanced Computing  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Introduction to fundamental concepts of computer science theory and methods of parallel and distributed programming. The course covers automata theory (including finite-state machines and Turing machines, algorithm complexity (including the distinction between P and NP problems), BNF specification of programming languages, methods of parallel programming, methods of distributed programming, measuring the speedup obtained by parallelization, and methods of addressing NP completeness through approximation. The course will provide experience in the implementation of parallel and distributed programming.

CS-310 Advanced Object-Oriented Programming and Design  Credits: 3
Term Offered: All Terms
Course Type(s): WT
Object-oriented programming and design, using a language different from that used on CS 176. Use of classes, inheritance, polymorphism, and libraries. Topics will include flexible system design for such requirements as globalization. This is a writing-intensive course.

CS-315 Theory of Computing  Credits: 3
Prerequisite(s): CS-176 passed with a grade of C or higher and either CS-202 or MA-120 or MA-130 passed with a grade of C or higher
Term Offered: Spring Term
Course Type(s): None
An introduction to phrase structure languages and their relation to automata, computability, and program verification.

CS-325 Software Engineering Concepts  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher; and EN-101 and EN-102 or permission of the instructor
Term Offered: All Terms
Course Type(s): WT
Overview of software engineering concepts, analysis/design techniques, Unified Modeling Language (UML), software documentation, and group development of software.

CS-335 Programming Language Concepts  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Course Type(s): None
Design, evaluation, and implementation of programming languages. Discussion of imperative, applicative, object-oriented and concurrent languages. Four hours per week.

CS-337 Enterprise Mobile Apps Design and Development  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Presents methodologies to build enterprise mobile apps on iPad tablets and iPhone smartphones using iOS. The course will cover technologies to use in the design and development of apps on mobile devices and integration of these apps with corporate data sources, sensor devices and cloud computing services. Also listed as SE-337.

CS-350 Research in Computer Science  Credits: 1-4
Prerequisite(s): CS-306 passed with a grade of C or higher, a minimum of fifteen credits at Monmouth University and a minimum GPA of 3.25
Course Type(s): EX5
Original research work, associated with an external constituent and/or organization, planned and carried out with assistance of faculty research advisor. Research conducted by the student will be shared with the external constituency and submitted for outside publication and review. Number of credits arranged with advisor. Limited to Computer Science students with approval of chair, program director, or advisor.

CS-357 Engineering Web-Based Systems  Credits: 3
Prerequisite(s): CS-176 and CS-176L
Term Offered: All Terms
Course Type(s): None
A practical introduction to the principles, methods, and tools required to create high-quality software applications for the distributed, client-server context of the Web. Emphasis is on architectural designs, and language and data access methods that are common in Web-based systems. Also listed as SE-357.

CS-358 Software Frameworks  Credits: 3
Prerequisite(s): SE-357 or CS-357; or permission of the instructor
Course Type(s): None
An introduction to Design Patterns and modern Software Frameworks, programming languages, data access methods and asynchronous Application Programming Interfaces (APIs). Also listed as SE-358.

CS-360 Introduction to Game Development  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
An introduction to the creation of computer/video games and the different elements of games, including computer graphics, animation, artificial intelligence, algorithms, data structures, networking, software development cycles and human-computer interaction. Also listed as SE-360.

CS-370 Program Development Under Unix  Credits: 3
Prerequisite(s): CS-176 passed with a grade of C or higher
Course Type(s): None
Introduction to the use of the UNIX operating system and its utilities for incremental and distributed program development, maintenance, and debugging. The course covers the UNIX shell, utilities, and program development tools that are used for large projects involving multiple developers on multiple machines. Three hours per week.
CS-371  Scripting Languages  Credits: 3
Prerequisite(s): CS-176 or equivalent
Term Offered: Spring Term
Course Type(s): None
An introduction to programming using widely-used, dynamically-typed, interpreted programming languages, which are sometimes called "scripting" languages. Covers general-purpose scripting languages, such as Perl and Python that are used to develop a wide range of applications. Scripting languages, such as PHP, that are used primarily in web development, will not be covered in this course.

CS-375  File Management  Credits: 4
Prerequisite(s): CS-205 passed with a grade of C or higher
Course Type(s): None
Overview of files, records and files, blocking and buffering, secondary storage devices; sequential file organization, external sort/merge algorithms; random access; relative file organization; tree-structured file organization; search trees, indexed sequential file organization; list-structured file organization; multiple-key file organization. Four hours per week.

CS-388  Cooperative Education: Computer Science  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher, Junior standing and thirty or more earned credits with at least fifteen taken at Monmouth University
Term Offered: All Terms
Course Type(s): EX1
Provides an opportunity for students who are engaged in a computer science-related experience. Fifteen to twenty hours of work experience per week. This course may be repeated for credit. Departmental approval is required to take this course.

CS-389  Internship in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): EX1
Supervised practical experience in Computer Science. Repeatable for credit. Junior standing, departmental approval, and placement are required to take this course.

CS-398  Special Topics in Computer Science (300 Level)  Credits: 1-3
Prerequisite(s): CS-176 or CS-275 passed with a grade of C or higher
Term Offered: Spring Term
Course Type(s): None
An intensive study of a particular subject or problem in computer science to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.

CS-399  Independent Study in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): None
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.

CS-414  Computer Networks  Credits: 3
Prerequisite(s): CS-286 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
An introductory-level course on the hierarchy of networking software and hardware. Emphasis on the description of protocols in the Internet, specifically, client-server Application Layer Protocols such as HTTP, SMTP, DNS, DHCP; Transport Layer Protocols such as UDP/TCP Network Layer Protocols such as IP ICMP as well as Network Layer Routing and Forwarding techniques, such as RIP and OSPF for IPv4 and Tunneling for IPv6.

CS-418  Compiler Construction  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Course Type(s): None
The principles and practices of incorporating the theory of finite automata and context-free languages, the maintenance and use of semantic information, and the generation and optimization of code to produce a compiler. Four hours per week.

CS-420  Survey of Artificial Intelligence Concepts and Practices  Credits: 3
Prerequisite(s): CS-205 and MA-130 both passed with a grade of C or higher
Term Offered: Fall Term
Course Type(s): None
Introduction of fundamental concepts and practices of artificial intelligence, covering search techniques, constraint satisfaction, knowledge representation, machine learning, planning, and natural language processing. The course will provide experience in the implementation of techniques from these areas. Three hours per week.

CS-432  Database Systems  Credits: 3
Prerequisite(s): CS-205 passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Overview of database system concepts; data modeling; ER and UML diagrams; relational database schema definition; database design; query languages; introduction to NoSQL and comparison between relational and non-relational databases; hand-on experience of SQL, Oracle, and NoSQL.

CS-438  Operating Systems Analysis  Credits: 3
Prerequisite(s): CS-286 and CS-205 both passed with a grade of C or higher
Term Offered: All Terms
Course Type(s): None
Management of memory, processes, files, and devices. OS design principles and performance measures. Multiprogramming, multiprocessing, concurrency, deadlock, virtual machines. Competitive and cooperating processes. Programs will be written in C or in Java. Three hours per week.

CS-450  Cyber Security  Credits: 3
Prerequisite(s): CS-205
Term Offered: Fall Term
Course Type(s): None
Cover fundamental theory and practice of cyber security. Review cryptographic tools used to provide security, such as shared key encryption; public key encryption, key exchange, authentication, digital signature, and intrusion detection. Learn implementation of secure mechanisms in object-oriented programming languages. Also listed as SE-450.
**CS-451  Applied Computer Security**  
Credits: 3  
Term Offered: Spring Term  
Course Type(s): None  
This course will introduce students to multiple aspects of computer security and practice into a series of well-defined security topics such as network security and hacking tools. Also, the student will introduce different topics of digital forensics. Also listed as SE-451.

**CS-471  System Administration**  
Credits: 3  
Prerequisite(s): CS-370 or CS-371 passed with a grade of C or higher  
Term Offered: Spring Term  
Course Type(s): None  
Fundamental topics in system administration, focused primarily on UNIX administration with added coverage of Microsoft Windows NT descendant systems. The course is a hands-on introduction to installing and maintaining modern, multi-user, production UNIX-like operating systems and the essential services that are hosted on these systems.

**CS-488  Cooperative Education: Computer Science**  
Credits: 3  
Prerequisite(s): CS-205 passed with a grade of C or higher  
Term Offered: All Terms  
Course Type(s): EX2  
Provides an opportunity for students who are engaged in a computer science-related experience. Fifteen to twenty hours of work experience per week. May be repeated for credit. Departmental approval is required to take this course. Junior standing, thirty or more earned credits with at least fifteen taken at Monmouth University and CS-205 passed with a grade of C or higher are required to take this course.

**CS-489  Internship in Computer Science**  
Credits: 1-3  
Term Offered: All Terms  
Course Type(s): EX1  
Supervised practical experience in Computer Science. Repeatable for credit. Junior standing, departmental approval, and placement are required to take this course.

**CS-490  Senior Project**  
Credits: 4  
Prerequisite(s): CS-325 and CS-432 both passed with a grade of C or higher  
Term Offered: Spring Term  
Course Type(s): RD  
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.

**CS-492A  Computer Science Senior Project A**  
Credits: 3  
Prerequisite(s): CS-325 and CS-432, both passed with a grade of C or higher  
Term Offered: All Terms  
Course Type(s): RD  
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.

**CS-492B  Computer Science Senior Project B**  
Credits: 3  
Prerequisite(s): CS-492A  
Course Type(s): RD  
Affords the student an opportunity to integrate topics and techniques from previous coursework in a capstone project. The project will combine investigation into computer science literature and actual implementation, either in an area of current research or an application area of interest to industry. Implementation might involve collaboration with other students. The project will be presented formally both orally and in written form. This course satisfies the reasoned oral discourse requirement for computer science students.

**CS-498  Special Topics in Computer Science (400 Level)**  
Credits: 1-3  
Term Offered: All Terms  
Course Type(s): None  
An intensive study of a particular subject or problem in computer science to be announced prior to registration. May be conducted on either a lecture-discussion or a seminar basis. Three or four hours per week. If a prerequisite is required it will be announced in the course schedule.

**CS-499  Independent Study in Computer Science**  
Credits: 1-4  
Term Offered: All Terms  
Course Type(s): None  
Independent study in a computer science topic not substantially treated in a regular course; for students with superior ability. One-hour consultation per week. Prior permission of the directing professor and department chair is required to take this course.