COMPUTER SCIENCE AND SOFTWARE ENGINEERING

Chair: Daniela Rosca, Department of Computer Science and Software Engineering

UNIX Administrator and Teacher: Joseph Chung

Master of Science in Computer Science (M.S.C.S.)

The Master of Science in Computer Science provides a broad background in graduate-level computer science study. The thirty- to forty-two-credit program allows the student to choose a thesis option or a non-thesis option. Students may also choose to specialize in Computer Networks, Databases and Intelligent Information Systems, or Security of Computer Systems and Networks. When the applicant has a strong background in computer science, such as a bachelor's degree in computer science with excellent standing, up to twelve credits (CS-501B Program Development (3 cr.) - CS-505 Operating Systems Concepts (3 cr.)) may be waived. Other majors may be required to take some or all of these courses. These foundation courses must be completed with a minimum GPA of 3.0, and all prerequisite courses must be passed with a grade of "B-" or better.

Master of Science in Information Systems (M.S.I.S.)

The M.S.I.S. is a unique degree program that educates students about how to apply computing technology to business programs. With courses offered through the School of Science and the Leon Hess Business School, the M.S.I.S. prepares students for employment in the Information Technology (IT) sector at a management level. The program benefits are:

• Focus on the technology or management side of information systems by choosing one of two distinct tracks;
• Become an effective team member, including teams that are international and geographically distributed;
• Excel at project management and management and improve business decision-making;
• Learn how to reconcile conflicting project objectives;
• Be eligible to apply for positions such as business systems analyst, software project manager, software requirements developer, information technology operations manager, and customer support specialist.

The M.S.I.S. also allows students to gain full and thorough training in information systems, which can be used as a basis for pursuing certifications such as the Certified Information Systems Security Professional (CISSP), Project Management Professional (PMP), and the Certified Software Development Professional (CSDP).

Master of Science in Software Engineering (M.S.S.E.)

Monmouth University was one of the first institutions in the United States to recognize the newly emerging discipline of Software Engineering by establishing a separate department to specialize in this strategic engineering discipline. The Department of Computer Science and Software Engineering offers a Master of Science Degree in Software Engineering.

The objective of the master's degree program is for the student to master the necessary skills and knowledge that allow him or her to be an effective member of a software development team. The program's educational objectives are to prepare students so that upon graduation they will:

1. Show mastery of the software engineering knowledge and skills and professional issues necessary to practice as a software engineer in a variety of application domains with demonstrated performance in at least one application domain;
2. Understand the relationship between software engineering and systems engineering and be able to apply systems engineering principles and practices in the engineering of software;
3. Show mastery of software engineering in at least one specialty, such as networked software systems, information systems, real-time systems, or software systems security.
4. Work effectively as part of a team, including teams that may be international and geographically distributed, to develop quality software artifacts, and to lead in one area of project development, such as project management, requirements analysis, architecture, construction, or quality assurance;
5. Reconcile conflicting project objectives, finding acceptable compromises within limitations of cost, time, knowledge, existing systems, and organizations;
6. Design appropriate software engineering solutions that address ethical, social, legal, and economic concerns;
7. Understand and appreciate the importance of feasibility analysis, negotiation, effective work habits, leadership, and good communication with stakeholders in a typical software development environment;
8. Learn new models, techniques, and technologies as they emerge, and appreciate the necessity of such continuing professional development;
9. Analyze a current significant software technology, be able to articulate its strengths and weaknesses, and be able to specify and promote improvements or extensions to that knowledge.

Classes are scheduled to support working professionals and many of our students are from New Jersey's premier software industries. The department offers the entire program at the main campus of Monmouth University. The Master of Science in Software Engineering degree is a thirty-credit curriculum, with four core courses, four advanced elective courses, and a six-credit thesis or practicum. The core courses provide the student with the foundations of modern software engineering. When the applicant has a background other than computer science or software engineering, up to twelve credits of foundation courses may be required before registering for the core courses. These foundation courses must be passed with a grade of "B-" or better. Students can opt for writing a thesis or participating in a group practicum for two semesters as their capstone experience before graduation.

For students who have already completed a bachelor's degree in software engineering, the department offers an advanced track, which gives students the opportunity to earn a master's degree after completion of a thirty-credit curriculum. In addition, students may choose between two paths within this track, the thesis or non-thesis option. If students choose the thesis option, they will complete the core courses, research and write a thesis over two semesters, and choose and complete two pairs of...
advanced elective courses. Students who choose the non-thesis option will complete the core courses and choose and complete three pairs of advanced elective courses. Finally, all students will take one advanced elective course from the list of non-paired courses.

**Programs Masters**

- M.S. in Computer Science, Thesis Track (http://catalog.monmouth.edu/graduate-catalog/science/computer-science-software-engineering/computer-science-ms-thesis-track)
- M.S. in Computer Science, Non-Thesis Track (http://catalog.monmouth.edu/graduate-catalog/science/computer-science-software-engineering/computer-science-ms-non-thesis-track)

**Faculty**

**Daniela Rosca**, Associate Professor and Chair (Graduate Faculty). M.S., Polytechnic University of Bucharest; Ph.D., Old Dominion University. Interests include requirements elicitation, analysis and specification, and methodologies for the development and use of business rules. drosca@monmouth.edu

**Richard Scherl**, Associate Professor (Graduate Faculty). B.A., Columbia University; M.A., University of Chicago, Ph.D., University of Illinois. Interests include software architecture, Petri nets, real-time systems, discrete event systems, telecommunications, and networking. rscherl@monmouth.edu

**Jiacun Wang**, Professor and Graduate Program Director (Graduate Faculty). B.S., Jiangsu University of Science and Technology; Ph.D., Nanjing University of Science and Technology, China. Interests include software architecture, Petri nets, real-time systems, discrete event systems, telecommunications, and networking. jwang@monmouth.edu

**Cui Yu**, Associate Professor (Graduate Faculty). B.S., Nanjing University of Aeronautics and Astronautics; Ph.D., University of Singapore, Singapore. Interests include database management systems, spatial databases, and information storage and retrieval. cyu@monmouth.edu

**Courses**

**CS-501A  Computer Programming Essentials**

- Credits: 3
- Term Offered: All Terms
- Course Type(s): TPS
- An introduction in computer programming for newly admitted graduate students. Students will learn basic concepts in modern computer programming. Students will complete all the programming exercises and assignments in the modern object-oriented language.

**CS-501B  Program Development**

- Credits: 3
- Prerequisite(s): CS-501A passed with a grade of B- or higher
- Term Offered: All Terms
- Course Type(s): None
- Continuation at the coverage of the same modern object-oriented language introduced in CS-501A. More advanced object-oriented design, including inheritance and polymorphism.
CS-502  Theoretical Foundations of Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): None
Concepts, methods, models, and associated computer exercises for important topics in discrete mathematics and probability. Includes: 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, graph theory, moments, random variables, and graph algorithms. Limited to Computer Science majors.

CS-503  Data Structures and Algorithms  Credits: 3
Prerequisite(s): CS-501B passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): None
Design and implementation of fundamental data structures and algorithms, including: linked lists, hashing, sorting, trees, stacks, queues, sets and bags, and recursion. Application to problem solving and object-oriented design of moderate-sized programs.

CS-505  Operating Systems Concepts  Credits: 3
Prerequisite(s): CS-503 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): None
The basic concepts of operating systems from the point of view of an advanced user: the interaction of the kernel, the command interpreter, and user processes. Focus is on process and resource management, concurrency control, and inter-process communication. Examples and projects are based mainly on Unix. The course also includes an introduction to computer architecture from an operating-systems perspective (processors, devices, interrupts, clocks, etc.).

CS-509  Advanced Object-Oriented Programming and Design  Credits: 3
Prerequisite(s): CS-501B passed with a grade of B- or higher
Term Offered: Fall Term
Course Type(s): None
Object-oriented programming and design, using a language different from that used in CS 501B. Used in classes, inheritance, polymorphism, and libraries.

CS-511  Technical Communication  Credits: 3
Term Offered: All Terms
Course Type(s): CISEL
Preparation, analysis, synthesis, and presentation of system documentation, technical papers, and data flow diagrams; literature search.

CS-512  Algorithm Design  Credits: 3
Prerequisite(s): CS-502 and CS-503 both passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): CISEL
Design and analysis of algorithms; dependence of algorithm efficiency on data structure choice; correctness of algorithm implementation and basic design techniques and their applications to programming with fundamental data structures.

CS-514  Networks  Credits: 3
Term Offered: All Terms
Course Type(s): CISEL
An introductory-level course on the hierarchy of networking software and hardware. Particular emphasis on medium Access Control, Network layer, Transport layer, and Session layer. Several MAC-layer protocols, TCP/IP. Also listed as MIS-514.

CS-517  Database Design and Management  Credits: 3
Prerequisite(s): CS-503 passed with a grade of B or higher
Term Offered: All Terms
Course Type(s): CISEL
Introduction to database systems, data modeling, design theory and methodologies, query languages and query processing. Coverage of relational database model and design, normalization process, SQL, hands-on database design and application development. Also listed as MIS-517.

CS-518  Fundamentals of Computer Security and Cryptography  Credits: 3
Prerequisite(s): CS-514 or MIS-514 passed with a grade of B- or higher
Term Offered: Fall Term
Course Type(s): CISEL
An introduction to computer security and its related issues, including cryptography. It covers threats assessment, security policies, basic cryptography, security mechanisms, and assurance. Also includes several case studies on enhancing the security level of specific systems by integrating different security mechanisms and techniques. Both theoretical and practical issues are addressed in the course. Students who successfully complete this course will be capable of assessing the threats, enhancing the security, and evaluating the assurance level of specific computer systems.

CS-520  Introduction to Intelligent Systems  Credits: 3
Prerequisite(s): CS-502 and CS-503 both passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
Introduction to methods and algorithms used to incorporate intelligence into computer programs. Topics include search techniques, representation and reasoning, and machine learning. Applications of these methods are stressed. Also covers implementation of some of the fundamental algorithms.

CS-521  Artificial Intelligence  Credits: 3
Prerequisite(s): CS-503 and CS-520 both passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): None
Basic and advanced methods in symbolic and quantitative artificial intelligence through Lisp programming techniques. Current issues concerning rule-based vs. statistical methods via applications.

CS-525  Simulation  Credits: 3
Prerequisite(s): CS-502, CS-503, and CS-514 all passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): None
Formal models of discrete event systems, computer simulation of models, and analysis of simulation results. Discrete event simulation is applied to studying the performance of computer and communication systems. Object-oriented design and programming in C++.

CS-529  Web Services and .NET  Credits: 3
Prerequisite(s): CS-503 passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): CISEL
Introduction to Web services. Theoretical and practical coverage of client-server architecture, communication protocols, and messaging, including XML and SOAP transactions. .NET Framework architecture is used for the applications. We contrast with other platforms, e.g., Java-based Web services. Students implement Web services and simple clients on PCs or mobile devices.
CS-532  Compiler Design  Credits: 3
Prerequisite(s): CS-512 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
The major techniques used in compiler writing, lexical analysis, syntax
analysis, storage management, error detection and recovery, and code
generation. Tools for compiler writing (LEX, YACC, etc.).

CS-533  Database System Implementation  Credits: 3
Prerequisite(s): CS-502 and CS-503 both passed with a grade of B- or higher
Term Offered: Fall Term
Course Type(s): CISEL
DBMS architecture, data storage and indexing, query processing and
optimization, transaction management and recovery, and some issues
related to advanced database applications.

CS-535  Telecommunications  Credits: 3
Prerequisite(s): CS-502, CS-505, and CS-514 all passed with a grade of B-
or higher
Term Offered: Fall Term
Course Type(s): None
In-depth coverage of the lower layers of the network hierarchy: Physical
layer, Data Link layer, Network layer, and Transport layer.

CS-536  File Management and Query Strategies  Credits: 3
Prerequisite(s): CS-503 passed with a grade of B or higher
Term Offered: Summer Term
Course Type(s): None
Addresses data storage and organization, file management principles,
and query processing and applications. Students will gain hands-on
experience in file processing and application development.

CS-550  Computer System Architecture  Credits: 3
Prerequisite(s): CS-502 and CS-503 both passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): None
Computer system interconnection structures, central processing unit,
control unit, microprogrammed control, memory organization, cache and
virtual memory, computer arithmetic, RISC processors, introduction to
parallel processing, and case studies.

CS-560  Master's Seminar  Credits: 3
Prerequisite(s): Completion of twenty-one credits toward the MS degree,
including four core courses, or permission of the instructor
Term Offered: All Terms
Course Type(s): CISEL
Emphasis on preparation, analysis, synthesis, and presentation of
software system documentation, project progress reports, and technical
papers based on literature research.

CS-588  Computer Science Practice and Experiences  Credits: 1
Prerequisite(s): 18 credits in Computer Science
Term Offered: All Terms
Course Type(s): None
Provides opportunity for Computer Science graduate students to obtain
related experience in employment at a local company or institution
with Monmouth University sponsorship. Available to Computer Science
graduate students who have completed at least eighteen credit hours
of graduate courses (500 level), with a minimum GPA of 3.00. Does not
satisfy elective requirements. Students may take the course a maximum
of two times. This is a pass/fail course. Departmental approval is
required to take this course.

CS-598  Special Topics in Computer Science  Credits: 3
Prerequisite(s): CS-520 and CS-503 both passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
Subject matter varies with the interest of the students and of the
professor teaching the course. The exact nature of the topic covered in
any given semester is indicated in the student's transcript.

CS-599  Independent Study in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): None
Independent study in a topic not substantially treated in a regular
graduate course, for students with superior ability; weekly consultation.
Prior permission of directing professor and the graduate program director
is required to take this course. This course can only be taken once for
credit. Completion of all foundation and core courses and a minimum
G.P.A. of 3.50 is required to take this course.

CS-611  Secure Web Services Design  Credits: 3
Prerequisite(s): CS-501B passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): CISEL
Web applications present a complex set of security issues for architects,
designers, and developers. The most secure and hack-resilient Web
applications are those that have been built from the ground up with
security in mind. This course focuses on principles of secure Web
applications design. Topics include threats and counter measures,
security in Web service frameworks, session control, access control, and
data protection. Also listed as SE-611.

CS-615  Data Mining  Credits: 3
Prerequisite(s): CS-517 and CS-520 both passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): CISEL
An introduction to the fundamental concepts, algorithms, and techniques
of data mining. Topics include: data preprocessing, classification
algorithms and techniques, anomaly detection, and the design of data
warehousing and OLAP systems.

CS-625  Internet Crawler  Credits: 3
Prerequisite(s): CS-529 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
In-depth coverage of the crawler component of modern search engines.
Examination of the architecture of crawlers; algorithms for visitation,
retrieval and processing of Web pages, and link analysis (e.g., PageRank
computation). Coverage of ethical and legal issues of customized Web
robots. Students build automatic Internet crawlers.
CS-628  Security of E-Systems and Networks  Credits: 3
Prerequisite(s): CS-518 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
The fundamental techniques in security of e-based Systems and
Computer Networks. E-based systems are ubiquitous in the modern
world with applications spanning e-commerce, e-government, e-
services, Virtual Private Networks (VPNs), health care, and government
organizations. Deals with the fundamental concepts and tools of security
of e-based systems and computer networks and its range of applications.
The topics to be covered include: authentication of users, system
integrity, confidentiality of communication, availability of business
service, non-repudiation of transactions, public key cryptosystems,
authentication and digital signature, e-security tools such as Public
Key Infrastructure (PKI) systems, biometric-based security systems,
trust management systems in communication networks, intrusion
detection systems, protecting against malware, and computer network
security risk management. Intended for graduate students in computer
science, software engineering, and electrical engineering who have
some background in computer networks and fundamentals of computer
security.

CS-635  Wireless Network Systems and Security  Credits: 3
Prerequisite(s): CS-514 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
Fundamental techniques in the design, operation, performance
evaluation, and security of wireless network systems. Among the topics
covered are first, second, third, and fourth generation wireless systems,
cellular wireless networks, medium access techniques, physical layer,
protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000,
etc.), fixed wireless systems, personal area networks (PANs) including
Bluetooth and Home RF systems, wireless local area network(WLAN)
technologies, architectures, protocols, and standards, and advanced
topics. Security of WLANs, wireless sensor networks (WSNs), cellular
systems, and Bluetooth and Home RF networks will be dealt with as
well. Intended for graduate students in computer science, software
engineering, and electrical engineering who have some background in
computer networks.

CS-661  Computer Science Advanced Project  Credits: 3
Term Offered: All Terms
Course Type(s): CISEL
A challenging project, such as the development of a large, complex
program, done under the supervision of a faculty member.

CS-691  Computer Science Thesis I  Credits: 3
Term Offered: All Terms
Course Type(s): None
Independent investigation of special topics reflecting the research
interests of the sponsoring professor. Provides students with an
opportunity to do extended relevant research in collaboration with, or
under the supervision of, a faculty member. Sequential registration of
one or more credits is required until successful completion. (Minimum of
six credits must be accumulated.) Completion of all foundation and core
courses and departmental approval is required to take this course.

CS-692  Computer Science Thesis II  Credits: 3
Prerequisite(s): CS-691
Term Offered: All Terms
Course Type(s): None
Independent investigation of special topics reflecting the research
interests of the sponsoring professor. Provides students with an
opportunity to do extended relevant research in collaboration with, or
under the supervision of, a faculty member. Sequential registration of one
or more credits is required until successful completion. (Minimum of six
credits must be accumulated.)

CS-698  Advanced Special Topics  Credits: 3
Prerequisite(s): CS-503 passed with a grade of B- or higher or as
announced in the course schedule
Term Offered: All Terms
Course Type(s): CISEL
The advanced subject matter varies with the interest of the students
and of the professor. The full syllabus for a specific offering will be filed
with the STE and Graduate School Deans when it is scheduled. The exact
nature of the topic covered in any given semester is indicated in the
student's transcript.

CS-699  Independent Study in Computer Science  Credits: 3
Term Offered: All Terms
Course Type(s): CISEL
Independent study of a subject not substantially treated in a regular
graduate course. Designed for students with superior abilities who, with
guidance and direction from the supervising faculty member, can master
a new subject. (Limited to students who have not yet taken CS-699.) A
minimum G.P.A. of 3.50, completion of all foundation and core courses
and departmental approval are required to take the course.

IT-500  Information Technology  Credits: 3
Term Offered: Fall Term
Course Type(s): None
Introduction to computer-based information management concepts
that provide an integrated approach to personal computer software in
a Windows environment. These include: word processing, spreadsheet,
database, presentation graphics, and electronic communication
applications; information retrieval from the Internet and online library
resources; fundamental computer literacy; and the ethical and societal
implications of computer technology. Hands-on experience with a
microcomputer in a networked environment is provided for completion of
individual and group projects. This course is appropriate only for students
from non-technology areas of study.

IT-510  Internet Technology  Credits: 3
Prerequisite(s): IT-500
Term Offered: Spring Term
Course Type(s): None
Introduction to integrated application software used for authoring and
publishing Web sites. Applications include, preprogrammed software,
markup programming and Internet scripting languages used to create
Web pages. Network technologies and the fundamental concepts
involved in creating a network and in facilitating network operation
will also be introduced. Hands-on experience with a microcomputer
on a networked system is provided for completion of individual and
group projects. This course is appropriate only for students from non-
technology areas of study.
MIS-514 Networks Credits: 3
Term Offered: All Terms
Course Type(s): None
An introductory-level course on the hierarchy of networking software and hardware. Particular emphasis on Medium Access Control, Network layer, Transport layer, and Session layer. Several MAC-layer protocols, TCP/IP. Also listed as CS-514.

MIS-517 Database Design and Management Credits: 3
Prerequisite(s): CS-503 passed with a grade of B or higher
Term Offered: All Terms
Course Type(s): None
Introduction to database systems, data modeling, design theory and methodologies, query languages and query processing. Coverage of relational database model and design, normalization process, SQL, hands-on database design and application development. Also listed as SE-627.

MIS-525 Information System Architecture Credits: 3
Prerequisite(s): MIS-565 or SE-565
Term Offered: All Terms
Course Type(s): None
Serves as an introduction to information systems architecture. The topics covered deal with an introduction to database systems, data models, the relational database model, the entity relation model, normalization, advanced data modeling, SQL, database design, transactions, performance, distributed database systems, and data warehouses. For MSIS students only. Also listed as SE-625.

MIS-550 Software Project Management Credits: 3
Prerequisite(s): SE-505
Term Offered: Fall Term
Course Type(s): None

MIS-551 Software Organization Management Credits: 3
Prerequisite(s): SE-505
Term Offered: Spring Term
Course Type(s): None
Management issues regarding the software process. Authority and delegation. Leadership and leadership paradigms. Software team management organization, staffing and evaluation. Organizational alternatives. Centralized vs. decentralized organizations. Managing design, development and testing teams. Managing software support organizations. Strategies for staffing: minimal vs. redundant staffing. Combining generalists and specialists to achieve an optimal staff configuration. Staff development and growth. Fostering professional growth within the organization. Evaluation strategies and techniques. Compensation and reward issues. For MSIS students only. Also listed as SE-651.

MIS-565 Software System Requirements Credits: 3
Prerequisite(s): CS-501A and SE-505, and SE-511
Term Offered: All Terms
Course Type(s): None
Students will learn advanced methods in software systems requirements. Ideally, these methods should be applied at the system, enterprise or global levels of software development. Methods in requirements elicitation, modeling of enterprises, prioritization and negotiation of requirements will be emphasized. Methods for including COTS into system applications and product families will be introduced. By the end of the course, students will master the standard documentation of system requirements. Many opportunities for hands-on experience with requirement tools will be provided throughout the course. For MSIS students only.

MIS-575 Software Verification, Validation and Maintenance Credits: 3
Prerequisite(s): CS-501A and SE-505
Term Offered: Fall Term
Course Type(s): None
Explores the techniques employed to assure quality in a software product developed in a controlled and disciplined environment. Detailed examination of software testing and inspection principles and methodologies. Provides specific methods for test case selection and inspection development leading to optimization of resource management in the software environment. For MSIS students only.

MIS-588 Information Systems Practice and Experience Credits: 1
Term Offered: Summer Term
Course Type(s): None
Provides opportunity for international Information Systems graduate students on an F1 student visa to obtain related experience via employment at a local company or institution, with Monmouth University sponsorship. Available only to Information Systems graduate students who have completed at least 18 credit hours of graduate courses (500-600 level), with a minimum G.P.A. of 3.00. This course does not satisfy elective requirements. Students may take this course a maximum of two times. Limited to MSIS students on an F1 Student Visa. This is a pass/fail course.

MIS-623 Management Information Systems Credits: 3
Term Offered: All Terms
Course Type(s): None
A survey of the concepts of management information systems and the information needs of management. A user-oriented introduction to the fundamentals of information systems and their integration into business organizations. Also listed as SE-623. Not open to students who have successfully completed BM-520.

MIS-691 Management Information System Thesis I Credits: 3
Prerequisite(s): BM-520, MIS-525, MIS-565 and either MIS-517 and MIS-514 and MIS-575 or BM-565 and MIS-550 and MIS-551
Term Offered: Fall Term
Course Type(s): None
First semester of independent research in management information systems, spanning a period of two consecutive semesters in an area not substantially covered in a regular course offering, under the supervision of a faculty member. A formal thesis is required. An oral defense of the thesis before a committee of two faculty members who teach MIS courses, plus the advising professor is required. Depending on the topic, a reviewer from outside the program faculty may be asked to serve as a committee member. For MSIS students only.
MIS-692 Management Information System Thesis II Credits: 3
Prerequisite(s): MIS-691
Term Offered: Spring Term
Course Type(s): None
Second semester of independent research in management information systems, spanning a period of two consecutive semesters in an area not substantially covered in a regular course offering, under the supervision of a management information systems faculty member. A formal thesis is required. An oral defense of the thesis before a committee of two faculty members who teach MIS courses, plus the advising professor is required. Depending on the topic, a reviewer from outside the program faculty may be asked to serve as a committee member. For MSIS students only.

MIS-695A Management Information System Practicum I Credits: 3
Prerequisite(s): BM-520 or MIS-623 and MIS-525 and MIS-565
Term Offered: All Terms
Course Type(s): None
A two-semester course sequence with major emphasis on a hands-on, team-oriented software development project. Students will be asked to form groups of three to five persons, which will work as a team whose purpose will be to propose, plan, develop and market a software product. The teamwork exercise will be accompanied by readings, lectures and seminar discussions on economics, organizational behavior and management, managerial and financial accounting, finance, marketing, quantitative business modeling, electronic commerce, logistics, ethics, law and social responsibility. For MSIS students only.

MIS-695B Management Information System Practicum II Credits: 3
Prerequisite(s): MIS-695A
Term Offered: All Terms
Course Type(s): None
A two-semester course sequence with major emphasis on a hands-on, team-oriented software development project. Students will be asked to form groups of three to five persons, which will work as a team whose purpose will be to propose, plan, develop and market a software product. The teamwork exercise will be accompanied by readings, lectures and seminar discussions on economics, organizational behavior and management, managerial and financial accounting, finance, marketing, quantitative business modeling, electronic commerce, logistics, ethics, law and social responsibility. For MSIS students only.

MIS-699 Individual Research Project in Management Information Systems Credits: 1-3
Course Type(s): None
The development and execution of a significant research project designed by the student in consultation with a Management Information Systems professor. An experience meant to focus learning on an area of special interest to the student. Prior permission of the directing professor and department chair is required to take this course.

SE-505 Principles of Software Engineering Credits: 1.5
Term Offered: All Terms
Course Type(s): None
Basic introduction to software engineering. Justification that software engineering is an engineering discipline. The two main components of the software engineering discipline - the software product and software process - will be discussed in detail. For design and verification, there will be a focus on traditional Structured-Analysis method. Limited to Software Engineering students only.

SE-511 Object-Oriented Analysis Credits: 1.5
Prerequisite(s): SE-505 passed with a grade of B- or higher
Term Offered: All Terms
Course Type(s): CISEL
Introduces the development of the requirements and analysis model for a software application. Uses object-oriented methodologies. This is not a programming course. Limited to Software Engineering students only.

SE-512 Object-Oriented Design Credits: 1.5
Prerequisite(s): SE-511 passed with a grade of B- or higher
Term Offered: Spring Term
Course Type(s): CISEL
Introduces the design of a software application. Uses object-oriented methodologies. This is not a programming course. Limited to Software Engineering majors only.

SE-515 Disciplined Software Development Credits: 3
Prerequisite(s): SE-505
Term Offered: All Terms
Course Type(s): None
Introduces the need for an engineering approach to software, through a motivational discussion of the so-called "software crisis" and a presentation of software development processes at the various degrees of granularity; this ranges from organizational processes to team and individual engineers' processes. Provides practical experiences with the Personal Software Process. A software process is defined as a set of guidelines, activities, and methods that engineers use to develop and maintain software. Without a software process, most projects are over budget and behind schedule, since successful efforts cannot be guaranteed. The success of a project depends greatly upon the experience and discipline of the engineers. Limited to Software Engineering students.

SE-517 Engineering Web-Based Systems Credits: 3
Prerequisite(s): CS-501A
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. The course emphasizes on architectural designs, and language and data access methods that are common in web-based systems.

SE-556 Software System Requirements Credits: 3
Prerequisite(s): CS-501A, SE-505, and SE-511
Term Offered: All Terms
Course Type(s): CISEL
Students will learn advanced methods in software system requirements. Ideally, these methods should be applied at the system, enterprise or global levels of software development. Methods in requirements elicitation, modeling of enterprises, prioritization and negotiation of requirements will be emphasized. Methods for including Commercial Off-the Shelf (COTS) system applications and product families will be introduced. By the end of the course, students will master the standard documentation of system requirements. Many opportunities for hands-on experience with requirements tools will be provided throughout the course.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisite(s)</th>
<th>Term Offered</th>
<th>Course Type(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-571</td>
<td>Software Design and Systems Architecture</td>
<td>1.5</td>
<td>SE-565</td>
<td>Spring Term</td>
<td>CISEL</td>
<td>Introduces software application design and system architecture in terms of the design process, design principles, design notations, design tools, design heuristics, and design patterns. Covers application and system design in detail concentrating on developing designs that are complete, correct, robust, implementable, and deployable. Limited to Software Engineering students only.</td>
</tr>
<tr>
<td>SE-572</td>
<td>Enterprise and Global Architecture</td>
<td>1.5</td>
<td></td>
<td>All Terms</td>
<td>CISEL</td>
<td>Introduces architectural design at the Enterprise and Global Architectural levels. Provides students with an understanding of how new systems are brought into an organization to interoperate with an existing system, how systems are maintained throughout their lifecycle, and how systems are retired at the end of their lifecycle. Also provides students with an understanding of how the computing capabilities of a company fits into the larger scope of the Internet. Limited to Software Engineering students only.</td>
</tr>
<tr>
<td>SE-575</td>
<td>Software Verification, Validation and Maintenance</td>
<td>3</td>
<td>CS-501A and SE-505</td>
<td>Fall Term</td>
<td></td>
<td>Covers software verification, validation and maintenance. The first half of the course includes inspections of requirements, design and code as well as testing. The second half addresses the handling of change requests, software evolution, code comprehension, and change management. It will include hands-on experience with a change management system and an automated testing tool.</td>
</tr>
<tr>
<td>SE-580</td>
<td>The Process of Engineering Software</td>
<td>3</td>
<td>CS-503 and SE-505</td>
<td>Spring Term</td>
<td></td>
<td>Students will learn how to define, apply and improve a software process. The basic components of a software process will be introduced, as well as the most influential process models. Students will experiment with both plan-based and agile methods of software development. The need for continuous process quality assessment and improvement will be described. Models such as CMM, ISO9001 will be introduced as reference models for organizations process models.</td>
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<tr>
<td>SE-588</td>
<td>Software Practice and Experience</td>
<td>1</td>
<td></td>
<td>All Terms</td>
<td></td>
<td>Provides opportunity for Software Engineering graduate students to obtain related experience in employment at a local company or institution, with Monmouth University sponsorship. Available to Software Engineering graduate students who have completed at least eighteen credit hours of graduate courses (500-level), with a minimum G.P.A. of 3.00 and eighteen completed credits. Does not satisfy elective requirements. Students may take this course a maximum of two times. This is a pass/fail course.</td>
</tr>
<tr>
<td>SE-599</td>
<td>Independent Study in Software Engineering</td>
<td>1-3</td>
<td>Completion of at least 12 credits in Software Engineering</td>
<td>All Terms</td>
<td>None</td>
<td>The development and execution of a significant research project designed by the student in consultation with a software engineering professor. This is an experience meant to focus learning on an area of special interest to the student. Prior permission of the directing professor and department chair is required to take this course.</td>
</tr>
<tr>
<td>SE-601</td>
<td>Outsourcing: Specifications and Strategies</td>
<td>3</td>
<td>SE-565 and SE-571</td>
<td>Fall Term</td>
<td></td>
<td>Covers issues associated with outsourcing software development in a fashion that assures delivery of acceptable products. The emphasis is on basic factors that determine the effectiveness of outsourcing, strategies for minimizing risk, project tracking, contract-specified breakpoints, and requirements.</td>
</tr>
<tr>
<td>SE-602</td>
<td>Technology Assessment</td>
<td>3</td>
<td>SE-565 and SE-571</td>
<td>All Terms</td>
<td>None</td>
<td>Covers the practicalities of assessing a technology for use in delivery of products. It examines how new tools, processes, and training fit into an overall technology-adoption decision.</td>
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<tr>
<td>SE-603</td>
<td>MOST Implementation</td>
<td>3</td>
<td>SE-565 and SE-571</td>
<td>Spring Term</td>
<td>None</td>
<td>A practical application of MOST concepts by following the process of adopting a new technology and putting the appropriate elements into an organization. Focuses on technology assessment, cost, scheduling, training, and project management.</td>
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<tr>
<td>SE-605</td>
<td>Software Implementation and Reuse</td>
<td>3</td>
<td>SE-565</td>
<td>All Terms</td>
<td>None</td>
<td>Explores contemporary topics in systematic software implementation and reuse. Includes the impact of Object-Based and Object-Oriented Design and Programming with Ada83, Ada95, and C++ along with Domain Engineering on the software development process. Concentrates on the practical aspects of applying architecture-centric, domain-specific, library-based reuse methodologies integrated with the software development process to create software systems in an efficient, cost-effective manner. Illustrates how object-oriented and domain-engineering techniques coupled with domain-specific libraries can be used to effectively develop significant software systems in a short period of time, frequently realizing reuse on the order of 70% or more. Libraries of object-based reusable software components will be used to design and implement solutions to problems.</td>
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</tbody>
</table>
SE-610  Software Systems Security  Credits: 3
Prerequisite(s): SE-505
Term Offered: Fall Term
Course Type(s): None
Threats, vulnerabilities, and attacks to network based systems. Heuristic procedures for breaking systems. UNIX and Internet case studies. Security modeling techniques including Bell-Lapadula, Biba, and Clark-Wilson. Composition of non-deducibility and noninterference security. Safeguard techniques including cryptographic protocols, online auditing and intrusion detection, access control, Internet firewalls, authentication, security kernel design, and trusted software development. Case studies in database security and secure network design.

SE-611  Secure Web Services Design  Credits: 3
Prerequisite(s): SE-565
Term Offered: All Terms
Course Type(s): None
Web applications present a complex set of security issues for architects, designers, and developers. The most secure and hack-resilient Web applications are those that have been built from the ground up with security in mind. This course focuses on principles of secure Web applications design. Topics include threats and counter measures, security in Web service frameworks, session control, access control, and data protection. Also listed as CS-611.

SE-615  Usability Engineering/Human-Computer Interaction  Credits: 3
Prerequisite(s): SE-565
Term Offered: Spring Term
Course Type(s): None
Explores the requirements analysis, design and evaluation of the Computer User Interface in the context of Software Engineering Processes. Specific methods and design problems will be illustrated with real-world examples in information technology, the Internet, communications, mobility, multimedia, and speech technologies. Prepares students to perform usability tasks directly or to successfully manage and collaborate with usability experts.

SE-616  Extensible Markup Language (XML)  Credits: 3
Prerequisite(s): CS-501B
Term Offered: Summer Term
Course Type(s): None
Presents XML fundamental concepts, XML as a document format, XML as a data format, and special topics in using XML.

SE-620  Networked Software Systems I  Credits: 3
Prerequisite(s): SE-565 and SE-571
Term Offered: Fall Term
Course Type(s): None
Network Computing Models, Concepts and Requirement specification; Techniques for Interprocess Communication; Message Passing; Remote Procedures Calls; Directory Service; Synchronization; Task Partition and Allocation; Threads; Security and Authentication; Time Management.

SE-621  Networked Software Systems II  Credits: 3
Prerequisite(s): SE-620
Term Offered: Spring Term
Course Type(s): None

SE-623  Management Information Systems  Credits: 3
Term Offered: All Terms
Course Type(s): None
A survey of the concepts of management information systems and the information needs of management. A user-oriented introduction of the fundamentals of information systems and their integration into business organizations. Also listed as MIS-623. Not open to students who have successfully completed BM-520.

SE-625  Information Systems Architecture  Credits: 3
Prerequisite(s): SE-565 or MIS-565
Term Offered: Fall Term
Course Type(s): None
Theoretical and practical issues related to the modeling and design of information systems to support medium to large organizations. The Target Architecture and its role in building enterprise-wide information systems. Operational, warehouse, departmental, and individual-level data. Data modeling levels and associated constructs: Entity-Relationship Diagrams, Data Item Sets, Physical Data Models. Process modeling levels and associated constructs: Functional decomposition, Context diagrams, Data Flow Diagrams, State transition Diagrams, HIPO charts, Pseudo-code and programming specs. Relationship with Object-based modeling. Also listed as MIS-525.

SE-626  Information Systems Engineering  Credits: 3
Prerequisite(s): SE-625
Term Offered: Spring Term
Course Type(s): None
Theoretical and practical issues related to the implementation of information systems to support medium to large organizations. Databases within the Target Architecture and their role in building enterprise-wide information systems. Logical vs. Physical database design. Transaction Processing (TPS) and Decision Support Systems (DSS): similarities and differences. Knowledge-based systems. Implementation issues; reliability, integrity, security, performance, scalability and maintainability. Review of existing commercial tools and environments for building, using and maintaining Information Systems for the enterprise.

SE-630  Real Time Software Analysis and Specification  Credits: 3
Prerequisite(s): CS-503 and SE-505
Term Offered: Fall Term
Course Type(s): None
SE-631  Real-Time Software Design and Implementation Credits: 3
Prerequisite(s): SE-630
Term Offered: Spring Term
Course Type(s): None
Criteria and trade-off for partitioning the functions of a real-time system among the hardware, firmware, and software. The interfaces of a real-time system to the external environments such as sensors and actuators. Designing real-time systems: structured and object-oriented methods. Case studies and comparison between the two. Design verification and validation. Implementation of Real-Time Systems. Development environments and tools: Simulators, Emulators and Debuggers. Testing Real-Time systems. Test coverage and regression testing. Special approaches for Real-Time software testing. Engineering and organizational issues in real-time software development. Performance testing and its importance in real-time systems.

SE-650  Software Project Management Credits: 3
Prerequisite(s): SE-505
Term Offered: Fall Term
Course Type(s): None

SE-651  Software Organization Management Credits: 3
Prerequisite(s): SE-505
Term Offered: Spring Term
Course Type(s): None

SE-652  Software Quality Management Credits: 3
Prerequisite(s): SE-565 and SE-571
Term Offered: Summer Term
Course Type(s): None
Designed to help students develop a broad understanding of the requirements and consideration in planning, managing, and implementing a software project with special emphasis on teams, quality, process, and measurement. This experiential course involves two iterations of a team project which help students learn how to apply specific software engineering practices and understand their value (or lack of value) to specific projects. The main themes include in-depth coverage of process models, such as CMMI and ISO 9000, as well as specific practices such as Risk Management, Configuration Management, Team Development, Inspections, and practical applications of Measurement.

SE-660  Computer System Architecture Credits: 3
Prerequisite(s): CS-503
Term Offered: All Terms
Course Type(s): None
Computer system interconnection structures, central processing unit, control unit, microprogrammed control, memory organization, cache and virtual memory, computer arithmetic, RISC processor, introduction to parallel processing, and case studies.

SE-691  Software Engineering Thesis Research Credits: 3
Prerequisite(s): SE-565, SE-571, and SE-580
Term Offered: All Terms
Course Type(s): None
Independent research in software engineering, spanning a period of two consecutive semesters in an area not substantially covered in a regular course offering, under the supervision of a software engineering faculty member. A formal thesis is required. An oral defense of the thesis before a committee of two faculty members, plus the advising professor is required. Depending on the topic, a reviewer from outside the software engineering department may be asked to serve as a committee member. Limited to Software Engineering majors.

SE-692  Software Engineering Thesis Research Credits: 3
Prerequisite(s): SE-691 and prior permission of the advising professor
Term Offered: All Terms
Course Type(s): None
Independent research in software engineering, spanning a period of two consecutive semesters in an area not substantially covered in a regular course offering, under the supervision of a software engineering faculty member. A formal thesis is required. An oral defense of the thesis before a committee of two faculty members, plus the advising professor is required. Depending on the topic, a reviewer from outside the software engineering department may be asked to serve as a committee member. Limited to Software Engineering majors.
SE-695A  Software Engineering Practicum  Credits: 3
Prerequisite(s): SE-565, SE-571, and SE-580
Term Offered: All Terms
Course Type(s): None
A two-semester course sequence with major emphasis on hands-on, team-oriented large software development projects. Students will be asked to form groups of three to five persons, who will work as a software team whose purpose will be to develop a software product. The particular product will be chosen through negotiation with the instructor. Teams will operate in accordance with a well-defined set of policies and procedures (documented in an SE Handbook) that governs the entire development process. This document process addresses work products, roles, activities, entry and exit criteria, reviews and audits, documented procedures, and training. The practicum will also include the use of a set of approved tools. Additional software project management topics such as planning, estimation, and tracking will be covered. Project management techniques and their application to the management of software projects. How to define a software development plan, its associated tasks, milestones, and deliverables. Software project scheduling and the establishment of relationships among the different tasks. Task dependencies and conflict resolution. Resource management and allocation. Software project cost estimation. Algorithmic models for estimating costs: the COCOMO model and its derivatives. Risk assessment and its impact in the planning and scheduling of software projects. Software project measurement and tracking. Comparative review of software tools for software project management. Software configuration management and its importance in the management of large software projects. The students will be asked to serve in team roles, hold oral reviews, and prepare documentation appropriate to their project. Students in the class will participate in the reviews of other teams in the class. At the end of the second semester, each team will give a formal presentation on the project. Limited to Software Engineering majors.

SE-695B  Software Engineering Practicum  Credits: 3
Prerequisite(s): SE-695A
Term Offered: All Terms
Course Type(s): None
A two-semester course sequence with major emphasis on hands-on, team-oriented large software development projects. Students will be asked to form groups of three to five persons, who will work as a software team whose purpose will be to develop a software product. The particular product will be chosen through negotiation with the instructor. Teams will operate in accordance with a well-defined set of policies and procedures (documented in an SE handbook) that governs the entire development process. This documented process addresses work products, roles, activities, entry and exit criteria, reviews and audits, documented procedures, and training. The practicum will also include the use of a set of approved tools. Additional software project management topics such as planning, estimation, and tracking will be covered. Project management techniques and their application to the management of software projects. How to define a software development plan, its associated tasks, milestones, and deliverables. Software project scheduling and the establishment of relationships among the different tasks. Task dependencies and conflict resolution. Resource management and allocation. Software project cost estimation. Algorithmic models for estimating costs: the COCOMO model and its derivatives. Risk assessment and its impact in the planning and scheduling of software projects. Software project measurement and tracking. Comparative review of software tools for software project management. Software configuration management and its importance in the management of a large software project. Students will be asked to serve in team roles, hold oral reviews, and prepare documentation appropriate to their project. Students will participate in the reviews of other teams in the class. At the end of the second semester, each team will give a formal presentation on the project. Limited to Software Engineering majors.

SE-698  Special Topics in Software Engineering  Credits: 3
Term Offered: All Terms
Course Type(s): None
The subject matter varies with the interest of the students and of the professor teaching the course. The exact nature of the topic covered in any given semester is indicated in the student's transcript. Approval of the department is required to take this course. If a prerequisite is required it will be announced in the course schedule.

SE-699  Individual Research Project in Software Engineering  Credits: 3
Term Offered: All Terms
Course Type(s): None
The development and execution of a significant research project designed by the student in consultation with a software engineering professor. An experience meant to focus learning on an area of special interest to the student. Prior permission of the directing professor and department chair is required to take this course.