Department of Mathematics and Computer Sciences

Computer Science (MS)
Learning Technologies (MS)
Instructional Design and Technology (MS)

GRADUATE CERTIFICATES
Learning Technologies
Instructional Design and Technology
Teaching Computer Science, K-8
Teaching Computer Science, 7-12
Virtual World in Education

The Department of Mathematics and Computer Science offers three master of science degrees: Computer Science, Learning Technologies and Instructional Design and Technology.

ACADEMIC POLICIES AND REGULATIONS
For detailed information on academic policies and regulations, including information relative to grade definitions, satisfactory progress, transfer of credit, etc., please refer to the graduate program information section in this catalog.

DUAL UNDERGRADUATE/GRADUATE ENROLLMENT
For detailed information on dual undergraduate/graduate enrollment, please refer to the graduate program information section in this catalog.

EDUCATOR’S DISCOUNT
Please refer to the graduate program information section in this catalog for detailed information on discounts.

MASTER OF SCIENCE IN COMPUTER SCIENCE (CS)
Computer Science is a field with a continuously expanding need for advanced knowledge and expertise. An MS degree in computer science from Fontbonne University will give you the tools needed to succeed and advance in this diverse industry. Fontbonne’s MS in Computer Science degree offers three tracks: Cyber Security, Data Mining and Software Engineering. It also offers three study plans: all course work, a master’s thesis or a master’s project. Our small class sizes will offer you the personal attention you need.

A student in the MS in Computer Science degree program may begin course work in fall or spring. There is no summer program start, however, summer courses will be offered.
ADMISSION
For the MS degree in Computer Science, these are the admission requirements:
1) Three letters of recommendations
   a) Letters of recommendation from persons qualified to evaluate a student’s recent work are required.
2) Official transcripts from all universities attended
   a) Applicants must have completed a baccalaureate in Computer Science or a related discipline before beginning the master’s program. Transcripts must show the following coursework, or students must complete the work prior to starting their MS degree.
      i) Calculus I and II
      ii) Discrete Math
      iii) Computer Architecture or Organization
      iv) Operating Systems
      v) C and (C++ or Java)
      vi) Data structures and algorithms
      vii) Database management
      viii) Elementary statistics course
3) Entrance examinations
   a) A minimum GRE score of 290 is required, with 150 quantitative and 140 verbal. The GRE test can be waived if any one of the following conditions is satisfied.
      i) BS in Computer Science from ABET accredited program
      ii) BS in Computer Science or related field with a gpa of 3.5/4.0
      iii) MS in related field
      iv) 3 years of field experience in IT related area
4) Grade Point Average
   a) 3.0/4.0 full acceptance as long as other criteria are met
   b) 2.75/4.0 conditional acceptance. Must maintain 3.0 gpa for first 6 hours of course work, with no grade below B-
5) Personal Statement
   a) In 500 – 600 words, tell us your goals and reason(s) for pursuing graduate study in computer science.
6) In addition, the following applies to international students.
   a) GPA 3.0/4.0 (There is no “conditional” admission for international students based on their academic GPA.)
   b) If a student submits foreign university transcripts that we cannot evaluate, then the student must submit a WES evaluation of his/her transcripts. (WES is World Education Services, a professional organization that will help with foreign transcript evaluation.)
   c) Language requirement: 70 internet-based TOEFL (IBT)/ 6.0 IELTS/ 280 Fontbonne University Standardized exam.
   d) Copy of passport
e) Completed international student application
f) Proof of financial support in the amount of $23,330 (if student is not the sponsor, a sponsorship affidavit of support is required)

APPLICATION
Information and application materials may be found at www.fontbonne.edu/eveonlineapp. To schedule an appointment or to learn more about our MS degrees you may call 314-863-2220 or email.
eveonline@fontbonne.edu In addition, you may contact Ms. Cheryl Burrus, administrative assistant, at cburrus@fontbonne.edu or 314-889-4508 or JoAnn Mattson, Director of the MS degree programs at jmattson@fontbonne.edu or 314-889-4514.

The application deadline for fall is June 1; for spring is October 1. There is no summer program start.

DEGREE REQUIREMENTS
The student must successfully complete 34 semester hours of graduate credit to earn a Master of Science degree in Computer Science.

Graduate Core Courses (12 credits)
Choose four of the following six courses
CIS 501 Advanced Algorithms and Data Structures (3 credits)
CIS 502 Advanced Operating Systems (3 credits)
CIS 503 Advanced Software Engineering (3 credits)
CIS 504 Advanced Computer Organization and Architecture (3 credits)
CIS 505 Advanced Database Systems (3 credits)
CIS 506 Advanced Computer Networks (3 credits)

Students must also take the Colloquium course:
CIS 510 Colloquium in Computer Science (1 credit)

Total of 13 hours of required course credit.

Elective Graduate Courses
Students can select elective graduate courses from within two different tracks or they may take a Special topics course or an internship.

Cyber Security Track
CIS 530 Network Security (3 credits)
CIS 535 Applied Cryptography (3 credits)
CIS 539 Topics in Cyber Security (3 credits)

Data Mining Track
CIS 540 Introduction to Data Mining (3 credits)
CIS 545 Advanced Data Mining (3 credits)
CIS 549 Topics in Data Mining (3 credits)
General Courses:
CIS 584 Internship in Computer Science (1-3 credits). May be taken for a maximum of 3 credit hours.
CIS 585 Independent Study in Computer Science (1-3 credits)
CIS 594 Special Topics in Computer Science (3 credits)

Students must choose from among three curriculum plans: A, B or C

Plan A – (Course Work Only)
Seven additional 3-credit courses selected from the core or elective courses listed above

Plan B – (Master Project)
Five additional 3-credit courses selected from the core or elective courses listed above
Two courses (six credits) devoted to a Master Project

Plan C – (Master Thesis)
Five additional 3-credit courses selected from the core or elective courses listed above
Two courses (six credits) devoted to a Master Thesis

MASTER OF SCIENCE IN LEARNING TECHNOLOGIES (LT)
The master of science (MS) degree in Learning Technologies is an online program for K through post-secondary educators who wish to address the technological learning challenges facing schools and educational organizations. The degree is designed to prepare educators to integrate technology into their teaching and curriculum in order to help prepare their students to meet tomorrow’s educational challenges. Educators include everyone interested in enhancing teaching and learning by using technology; K-12 teachers, community and four-year college instructors - anyone who is charged with the professional development of their colleagues.

Our program helps educators develop the professional skills, knowledge, and perspective necessary to stay current and relevant in today’s electronic age. Our students learn to work with computers and computer-supported technologies as educators – not as technology experts. This online program is ideal for teachers and other educational leaders who want to learn to lead the way for meaningful technology integration. Our faculty members prepare educators to handle differentiated learning styles and the numerous challenges that they face daily in an educational environment.

Within the MS in Learning Technologies degree program a student may earn one of four graduate certificates:
Teaching Computer Science K-8, Teaching Computer Science 7 – 12, Virtual Worlds in Education or Learning Technologies. The latter two are fully online while the first two offer both online and face-to-face courses.

A student in the MS in Learning Technologies degree program may begin course work in any of three semesters: fall, spring or summer.

TRANSFER OF CREDIT
For the master of science degrees in Learning Technologies a student may transfer a maximum of two graduate-level courses into the program from an accredited, degree-granting institution of higher education. The course content must be comparable to the content of a course within one of the master’s programs offered by the department. The grade received must be B or higher. The course must have been taken within three years prior to admittance into the master of science degree program in Learning Technologies.

ADMISSION
Admission requirements for the MS degrees in Learning Technologies:
1. A minimum undergraduate GPA of 3.0 on a 4.0 scale is required for full acceptance. Others may be admitted on probationary status pending demonstration of ability to perform quality work at the graduate level.
2. Three letters of recommendation, one of which is from a supervisor or recent academic advisor, are required. If this is not possible, please contact the department chair.
3. A self-statement, indicating the reasons for desiring to earn a master’s degree in Learning Technologies or Instructional Design and Technology is required.

All credentials submitted for admission must be on file no later than one week prior to final registration for the term in which the applicant wishes to begin.

APPLICATION
Information and application materials may be found at www.fontbonne.edu/eveonlineapp. To schedule an appointment or to learn more about our MS degrees you may call 314-863-2220 or email eveonline@fontbonne.edu In addition, you may contact Ms. Cheryl Burrus, administrative assistant, at cburrus@fontbonne.edu or 314-889-4508 or JoAnn Mattson, Director of the MS degree programs at jmattson@fontbonne.edu or 314-889-4514.
DEGREE REQUIREMENTS
The student must successfully complete 33 semester hours of graduate credit to earn a Master of Science degree in Learning Technologies at Fontbonne University.

Students may demonstrate mastery of the content in CED 515, Computer Applications for Educators. If mastery is demonstrated then a student must take four required courses and choose from among seven electives. If competency is not demonstrated then the student must take CED 515 as one of the required course in addition to the four required courses listed below and choose six electives from among courses in the elective list.

Four required courses:
CED 505 Teaching Technology and Learning Theory (3 credits)
CED 507 Instructional Technology Tools for the 21st Century (3 credits)
CED 515 Computer Applications for the Educator (3 credits) **
CED 565 The Internet and Education (3 credits)
CED/IDT 595 Culminating Project and Capstone Portfolio (3 credits) (must be taken during final semester)

** A student must take a competency test in CED 515. If he/she passes the competency then that student will choose another CED or IDT elective to replace CED 515. If he/she does not pass the competency test then that student must take CED 515.

Seven remaining elective courses from the following online courses:
CED 511 Foundations of Computer Science for Teachers
CED 525 Legal and Ethical Technology Issues
CED 535 Instructional Games and Simulations
CED 551 Virtual Worlds in Education
CED 552 Creating a Presence in a Virtual World
CED/IDT 530 Instructional Games and Simulations
CED 553 An Immersive Experience in a Virtual Learning Community
CED 540 Introduction to Programming for Educators: C++
CED 547 Robotics
CED 549 Programming in Java
CED 560 Current Programming Languages
CED 563 Visual Basic
CED 568 Differentiated Instruction Using Technology
CED 570 Emerging Technologies in Education
CED 571 Topics in Computer Science
CED 573 Multimedia, Graphic and Web Design for Instruction
CED 577 Research in Learning Technologies
CED 592 Online Course Design and Teaching
IDT 500 Foundations of Instructional Design Systems
IDT 501 Processes of Instructional Design and Technology Systems

NOTE: At times CED 594 Special Topics in Learning Technologies may be offered.

MASTER OF SCIENCE IN INSTRUCTIONAL DESIGN AND TECHNOLOGY (IDT)
The Master of Science (MS) degree in Instructional Design and Technology is for adult learners who want to create and deliver educational training materials (e.g., eLearning courses, videos, manuals, handouts, etc.) for businesses, higher-educational institutions, and other organizations.

The degree is designed to prepare individuals to assume positions as corporate trainers, performance consultants, instructional designers, technology coordinators, technology consultants, or educational software designers. This online degree prepares its students to work in a variety of environments: government agencies, higher-education institutions, nursing training programs, online education programs, corporate training and even preK-12 schools.

Some of the jobs an instructional designer may perform are: evaluate new technologies to discover new and better ways to enhance instruction, assist colleagues in discovering methods of improving their instruction with technology, conduct training sessions on how to use new technologies, conduct research studies evaluating the use of technologies and their impact on learning outcomes, create training materials to accommodate self-learners, manage the implementation of new technologies for the use of instruction.

This degree is useful for anyone in all careers that focus on the use of design and technology in instruction.

A student in the MS in the Instructional Design and Technology degree program may begin course work in any the three semesters, fall, spring or summer, but it is preferred that he/she begin in fall.

TRANSFER OF CREDIT
For the master of science degrees in Instructional Design and Technology, a student may transfer a maximum of two graduate-level courses into the program from an accredited, degree-granting institution of higher education. The course content must be comparable to the content of a course within one of the master’s programs offered by the department. The grade received must be B or higher. The course must have been taken within three years prior to admittance into the master of science degree program in Instructional Design and Technology.
ADMISSION
Admission requirements for the degree in Instructional Design and Technology:
1. A minimum undergraduate GPA of 3.0 on a 4.0 scale is required for full acceptance. Others may be admitted on probationary status pending demonstration of ability to perform quality work at the graduate level.
2. Three letters of recommendation, one of which is from a supervisor or recent academic advisor, are required. If this is not possible, please contact the department chair.
3. A self-statement, indicating the reasons for desiring to earn a master’s degree in Learning Technologies or Instructional Design and Technology is required.

All credentials submitted for admission must be on file no later than one week prior to final registration for the term in which the applicant wishes to begin.

APPLICATION
Information and application materials may be found at www.fontbonne.edu/eveonlineapp. To schedule an appointment or to learn more about our MS degrees you may call 314-863-2220 or email eveonline@fontbonne.edu In addition, you may contact Ms. Cheryl Burrus, administrative assistant, at cburrus@fontbonne.edu or 314-889-4508 or JoAnn Mattson, Director of the MS degree programs at jmathison@fontbonne.edu or 314-889-4514.

DEGREE REQUIREMENTS
The student must successfully complete 36 semester hours of graduate credit to earn a master of science degree in Instructional Design and Technology at Fontbonne University.

Twelve required courses:
- IDT 500 Foundations of Instructional Design Systems
- IDT 501 Processes of Instructional Design and Technology Systems
- IDT 535 Instructional Games and Simulations
- IDT 573 Multimedia, Graphic and Web Design for Instruction
- IDT 590 Current Topics in Instructional Design and Technology
- IDT 595 Culminating Project and Capstone Portfolio
- CED 505 Teaching Technology and Learning Theory
- CED 507 Instructional Technology Tools for the 21st Century
- CED 515 Computer Applications for Educators **
- CED 565 The Internet and Education
- CED 551 Virtual Worlds in Education
- CED 552 Creating a Presence in a Virtual World

** A student may choose to take a competency test in CED 515. If he/she passed the competency then that student may choose another CED or IDT elective to replace CED 515. If he/she does not pass the competency test then that student must take CED 515.

The optimal sequence in which the courses for the MS degree in Instructional Design and Technology should be taken is:

Fall 1: IDT 500 and CED 565,
Spring 1: IDT 501 and CED 575,
Summer 1: CED 507 and CED 566
Fall 2: CED 505 and CED 592,
Spring 2: CED 525 and IDT 530,
Summer 2: IDT 590 and IDT 595

GRADUATE CERTIFICATE REQUIREMENTS
Transfer of Credit
For the graduate certificates in this department, a student may transfer, at most, one graduate-level course from an accredited, degree-granting institution of higher education. The course content must be comparable to the content of a course within one of the master’s programs offered by the department. The grade received must be B or higher. The course must have been taken within three years prior to admittance into the program.

The student must complete 15-18 semester hours of graduate credit with a cumulative GPA of 3.0 or higher.

LEARNING TECHNOLOGIES
Required courses for the graduate certificate in Learning Technologies:
CED 505 Teaching Technology and Learning Theory
CED 507 Instructional Technology Tools for the 21st Century
CED 515 Computer Applications for Educators **
CED 565 The Internet and Education

** A student may choose to take a competency test in CED 515. If he/she passed the competency then that student may choose another CED or IDT elective to replace CED 515. If he/she does not pass the competency test then that student must take CED 515.

One elective course chosen from among the other courses offered within the program.

VIRTUAL WORLDS IN EDUCATION
Required courses for the graduate certificate in Virtual Worlds in Education:
CED 515 Computer Applications for Educators **
CED 565 The Internet and Education
CED 551 Virtual Worlds in Education
CED 552 Creating a Presence in a Virtual World
CED 553 An Immersive Experience in a Virtual Learning Community

** A student may choose to take a competency test in CED 515. If he/she passed the competency then that student may choose another CED or IDT elective to replace CED 515. If he/she does not pass the competency test then that student must take CED 515.

INSTRUCTIONAL DESIGN AND TECHNOLOGY

Required courses for the graduate certificate in Instructional Design and Technology:
CED 507 Instructional Technology Tools for the 21st Century
CED 515 Computer Applications for Educators (Note, this course is only required if one does not demonstrate competence in the course content.)
CED 565 The Internet and Education
CED 592 Online Course Design and Teaching
IDT 500 Foundations of Instructional Design Systems
IDT 501 Processes of Instructional Design and Technology Systems
IDT 573 Multimedia, Graphic and Web Design for Instruction

TEACHING COMPUTER SCIENCE, K-8

Required course:
CED 511 Foundations of Computer Science for Teachers (3 credits)
CED 540 Programming with C++ (3 credits)
CED 560 The Fundamentals of Programming (3 credits)
CED 565 The Internet and Education (3 credits)

TEACHING COMPUTER SCIENCE, 7-12

Required courses:
CED 511 Foundations of Computer Science for Teachers (3 credits)
CED 540 Programming with C++ (3 credits)
CED 549 Programming in Java (3 credits)
CED 560 The Fundamentals of Programming (3 credits)
CED 565 The Internet and Education (3 credits)

COURSES

CED 505 Teaching Technology and Learning Theory (3 credits)
Provides practical, effective ways to integrate technology resources and technology-based methods into instructional settings, both in the classroom and in corporate training settings. Topics include current theories of cognition and learning, cognitive load theory, and effective teaching practices for both traditional-age students and the adult learner. Emphasis is placed on using technology to produce a cognitive-active approach to learning and to design questioning strategies that develop critical thinking. Students connect theories of teaching and learning to the use of technology in a variety of instructional settings. They learn to reflect on the use of instructional technology. Students develop professional alignments with national standards. FA

CED 507 Instructional Technology Tools for the 21st Century (3 credits)
Provides educators with knowledge and guided practice to effectively use software, the Internet and other technology resources available in education. Activities completed in this class act as a springboard for a future of a technology rich curriculum with the aim of transforming students into lifelong learners. SU

CED 511 Foundations of Computer Science for Teachers (3 credits)
Provides an introduction to computer science as a discipline. The course presents an introduction to computer hardware and software, the history of computers, the Internet and the Web as well as computers and society. An emphasis will be placed on computer vocabulary. Topics include, but are not limited to, the study of how computers function, how the Internet works, an overview of programming languages and algorithms, basic number systems, Boolean expressions and ethical considerations.

CED 515 Computer Applications for Educators (3 credits)
Introduces the student to computer applications using Microsoft Office suite. The applications include Word, PowerPoint, Publisher, Excel, Publisher and online collaboration suites. The emphasis will be on the use of these applications in the educational environment. FA, SP, SU

CED 525 Legal and Ethical Technology Issues (3 credits)
Introduces the ethical and legal issues related to the use of technology in instruction. Students will examine the current debates surrounding the integration of technology into the instructional process. They will study the issues of information and intellectual property, privacy in a digital environment, and accessibility and Universal Design. The relationship of individual, governmental and societal
concerns in a constantly-changing electronic community will also be studied. SP

CED/IDT 535 Instructional Games and Simulations (3 credits)
Provides an in-depth study of the theoretical and practical issues surrounding the use of games and simulations in learning environments. Methods and approaches for integrating existing games into learning environments and for developing new simulations and games around content will be researched, evaluated and developed. SP

CED 540 Programming with C++ (3 credits)
Teaches structured programming design concepts using C++. Emphasizes programming to direct computer’s actions in a structured manner. Prerequisite: Knowledge of operating system. FA

CED 547 Robotics (3 credits)
Introduces students to the concepts, techniques and applications of robotics. Students will learn the basics of modeling, designing, planning, programming and controlling of robot systems. Students will learn to program a robot that can be used in their classes with their own students and how to teach the essentials of robotics to their students. SU

CED 549 Programming in Java (3 credits)
Introduces students to the Java programming language in order to teach programming as a systematic discipline and as a problem-solving tool. Topics include fundamental concepts of object-oriented programming, encapsulation, inheritance and polymorphism, classes, objects, files and aggregation. Students in this course will learn how to teach the essentials of Java to their students.

CED 550 Current Programming Languages (3 credits)
Introduces students to a programming language in order to teach students a systematic discipline and as a problem-solving tool. Acquaints students with fundamental concepts of computers, information processing, algorithms, and programs. SP

CED 551 Virtual Worlds in Education (3 credits)
Provides an introduction to virtual worlds and their application to learning environments. Students will learn the psychology and philosophies of virtual environments and their impact on learning both now and in the future. Students will investigate and participate in various virtual worlds, learn the basic skills necessary to create their own virtual environments, and integrate learning activities into a virtual world in order to motivate and challenge their audience. Since virtual environments promise to be a significant component of our online existence, this course is an opportunity to experience them firsthand and discover their potential. FA

CED 552 Creating a Presence in a Virtual World (3 credits)
This course will provide students with the opportunity to become participating citizens of one of the most innovative and creative virtual worlds. Students will go beyond the basics to become competent builders, scriptors, animators, designers, machinima makers, etc. They will also apply the basic elements of game design to produce quality educational activities and simulations for use in both the virtual and real worlds. Prerequisite: CED 551. Offered as needed.

CED 553 An Immersive Experience in a Virtual Learning Community (3 credits)
Students will have the opportunity to define their own presence in a virtual world by creating their own learning path. Based on the skills and experiences gained from previous courses, the students will explore and examine individual interests in the virtual environment with the guidance and direction of the instructor. Areas of interest could include such topics as: Researching Behavior in the Virtual World, Creating a Unique Environment or Learning Community in the Virtual World, Designing Educational Strategies for use in the Virtual World, Starting a Business in the Virtual World, etc. Prerequisite: CED 552. Offered as needed

CED 556 Current Programming Languages (3 credits)
Provides basic knowledge and guided practice to effectively use the Internet and telecommunications resources. Coursework will act as a springboard for valuable communication in the classroom and for personal use. FA, SP, SU

CED 568 Differentiated Instruction Using Technology (3 credits)
Explores the ways technology tools are used to differentiate instruction in all content areas. Based on research, educators will devise practical learning strategies to engage their students. Those educators that are not in classroom settings will focus on how differentiated instruction fits with adult learning and training models. FA

CED 570 Emerging Technologies in Education (3 credits)
Provides a foundation for the understanding of computer hardware, including internal parts and peripherals.
Develops criteria for the selection and the appropriate utilization of computer hardware within an educational environment. Promotes discussions on the selection of computer hardware and offers video streaming to assist in the explanation of specific working parts of a computer. SU

CED 571 Topics in Computer Science (3 credits)
Introduces students to some advanced topics in computer science, such as computer networks and security. Topics will also include an introduction to data structures (binary trees, linked lists). Other topics may include recursion, pointers, encryption, logic, and data storage. To assist classroom teachers, discussions of our changing world due to the advances in technology will also be a part of this course.

CED/IDT 573 Multimedia, Graphic and Web Design for Instruction (3 credits)
Emphasizes design elements, principles, development, and strategies used to produce effective multimedia presentations, quality websites, and original graphics. Learners will use current Web 2.0 tools, presentation and video screen capturing software and other available applications to create quality productions for instructional and personal use. SP

CED 577 Research in Learning Technologies (3 credits)
Introduces students to research in learning technologies. Students will investigate at least 5 areas in which research in computer education takes place. Students will select topic(s) based on this original investigation and their own interests and perform a research study. As a result of the course, students will advance both their Internet and database research skills and their skills as an educator integrating technology into the educational environment. Interpretation, analysis, and synthesis of current research in computer will be focal points of this course. Offered as needed.

CED 592 Online Course Design and Teaching (3 credits)
Provides students with the basis for designing and teaching an online course. Topics will include the following: creating a welcoming environment, developing a detailed syllabus for online students, stating measurable learning objectives, creating an online course that is easy to navigate, communication, assessment in an online course and methods of presenting content in an online course. The mechanics of using an online course management tool will also be presented. FA

CED 594 Special Topics in Learning Technologies (3 credits)
Covers current and relevant topics not regularly covered in the set of required and elective courses for the MS in Learning Technologies degree. Prereq: completion of at least 12 semester hours and consent of department chair. Offered as needed.

CED 595/IDT 595 Culminating Project and Capstone Portfolio (3 credits)
This course consists of two main parts: 1. Extends students’ knowledge of the instructional applications of computers and technology. Research into current curriculum theory and development will be the basis for modeling educational activities that enhance instruction. Based on all previous coursework, students will determine the applications that can be used to design specific learning activities. 2. Provides a framework for students to compile a Capstone Portfolio that will consist of three major components. The portfolio will demonstrate the student’s over-all knowledge, abilities, and progress throughout the master’s degree process as well as a personal reflection essay and an assessment of the Masters’ program in Learning Technologies or Instructional Design and Technology. FA, SP, SU

CIS 501 Advanced Algorithms and Data Structures (3 credits)
Presents an in-depth study of algorithms and data structures. Topics include concepts and skills needed to analyze algorithms, advanced data structures, dynamic data structures, complexity theory and theories of computation. Prerequisite: CIS 250 or consent of instructor.

CIS 502 Advanced Operating Systems (3 credits)
Presents an in-depth study of advanced topics in the field of operating systems. Topics include distributed file systems and structures, multiprocessor operating systems, parallel and concurrent programming, scheduling and resource/memory management. Prerequisite: CIS 355 or consent of instructor.

CIS 503 Advanced Software Engineering (3 credits)
Presents an in-depth study of advanced topics in the field of software engineering. Topics include software requirements workflow, object-oriented analysis and design workflow, implementation workflow, testing workflow, quality assurance, software reliability and testing methods. Prerequisite: CIS 475 or consent of instructor.
CIS 504 Advanced Computer Organization and Architecture (3 credits)
Presents an in-depth study of computer organization and architecture. The focus of the course is on increasing the speed of processor execution and optimizing energy efficiency. Topics include parallel processing, multiple cores, pipelining and caching. Issues such as data synchronization and advanced mathematical structures are covered. Current advances in processor design that affect program execution speed are also presented. Prerequisite: CIS 310 or consent of instructor.

CIS 505 Advanced Database Systems (3 credits)
Presents an in-depth study of the foundations of designing and implementing relational database management systems. Topics include data representation, indexing, query processing and optimization. Prerequisite: CIS 330 or consent of instructor.

CIS 506 Advanced Computer Networks (3 credits)
Presents an in-depth study of the foundations of designing and implementing computer communication networks, network protocols and applications. Topics include network programming (e.g. sockets) and 5-layer network architecture: physical layer, data link protocols, network routing layer and transport layer protocols (e.g TCP and UDP), and application layer (e.g. http and https). Prerequisite: CIS 340 and Unix Programming or consent of instructor.

CIS 510 Colloquium in Computer Science (1 credit)
Seminars that consist of a series of individual presentations by faculty, students or guest speakers. Prerequisite: consent of the instructor.

CIS 530 Network Security (3 credits)
Presents an in-depth study of advanced topics in the field of network security. Topics include the applications of cryptographic concepts to the field of network security, risks and vulnerabilities of network data, countermeasures to fight cyber attacks, digital signatures, and various network security technologies that are applied to email, e-commerce, web transactions and IP networks. Prerequisites: CIS 340 and 345 or consent of instructor.

CIS 535 Applied Cryptography (3 credits)
Presents an in-depth study of advanced topics in the field of applied cryptography. Topics include mathematical background necessary to understand, implement, and break modern cryptographic algorithms such as prime number factoring, advanced/complex cryptographic algorithms and their implementations in software and hardware. Additional topics include advanced decryption and vulnerability, block modes, random and pseudorandom number generators, secret sharing, zero-knowledge, and quantum cryptography. Background knowledge in complexity of algorithms and theory of computation will be helpful for understanding the materials. Prerequisite: CIS 395 or consent of instructor.

CIS 539 Topics in Cyber Security (3 credits)
Presents advanced topics in cyber security. Potential topics include “Computer Security and Privacy” and “Advanced Digital Forensics”. Prerequisite: CIS 496 or consent of instructor.

CIS 540 Software Engineering in an Enterprise Environment (3 credits)
Presents the design and execution of large software projects. Topics include life cycle models, planning, resource and time estimation, and integration of large projects. Tools used in the design of projects, such as UML-based tools will also be presented. Team-design practices will be stressed in product definition, creation, analysis and testing. Prerequisite: CIS 503 or consent of instructor.

CIS 545 Software Quality Analysis and Testing (3 credits)
Presents the study and use of software analysis and testing. Topics include the requirements of test planning, white box and black box testing, bottom up and down testing strategies and other industry standard test methods. Additional topics include automated and unit testing as well as COBRA. A variety of software quality analyses used in industry will be presented. Prerequisite: CIS 504 or consent of instructor.

CIS 549 Topics in Software Engineering (3 credits)
Presents advanced topics in software engineering. Potential topics include “reuse” and “reengineering” concepts and skills. Prerequisite: CIS 545 or consent of instructor.

CIS 550 Introduction to Data Mining (3 credits)
Presents an overview of concepts, issues, activities and techniques of data mining. Topics include the preparation of data, feature selection, classification, association rules, clustering, spatial and sequence mining. Prerequisites: CIS 505, Advanced Database Systems, and MTH 315. MTH 200 would be helpful but not required.

CIS 555 Advanced Data Mining (3 credits)
Presents advanced topics in data mining. Topics include extensions to classification and clustering; and association rule discovery, sequential pattern discovery, regression and data warehousing. Prerequisite: CIS 550 or consent of instructor.
CIS 559 Topics in Data Mining (3 credits)
Presents current topics in data mining. Potential topics include predictive modeling, the data preparation steps of analysis, learning and modeling, and identifying the predictive/descriptive model that produces the best evaluation scores. Successful completion of the course will ensure preparedness for complex real-life data mining tasks. Prerequisite: CIS 555 or consent of instructor.

CIS 584 Internship in Computer Science (1-3 credits)
Provides a supervised off-campus, field-based experience, in computer science, at an approved site specifically related to the career goal(s) of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. A maximum of three credit hours earned under the title of CIS 584 can be applied to the degree requirements. Prerequisite: successful completion of nine graduate credit hours with an overall GPA of 3.0. Offered on P/F basis.

CIS 585 Independent Study in Computer Science (1-3 credits)
Study in a specialized area, to be arranged according to the student need/interest and availability of instructor. Prerequisite: consent of program director.

CIS 590 Master Project (1–6 credits)
Research project conducted under the direction of major advisor. Students must take CIS 590 for at least 6 credit hours. Prerequisite: Successful completion of core courses

CIS 592: Master Thesis (1-6 credits)
Research on a thesis topic conducted under the direction of major advisor. Students must take CIS 592 for at least 6 credit hours. Prerequisite: Successful completion of core courses

CIS 594: Special Topics in Computer Science (3 credits)
Covers current and relevant topics not regularly covered in the set of required and elective courses for the MS in Computer Science degree. Prerequisite: Consent of the department chair

IDT 500 Foundations of Instructional Design Systems (3 credits)
Introduces students to the discipline of instructional design. Students learn to analyze professional development needs in educational and corporate environments and to translate those needs into the design and development of quality training opportunities. Students will be introduced to the elements of instructional design; needs analysis, task analysis, learner analysis, planning and creating instruction, and evaluation. FA

IDT 501 Processes of Instructional Design and Technology Systems (3 credits)
Provides students an opportunity to apply the instructional design principles studied in IDT 500. This course focuses on the design, development and assessment of instructional design products and on conducting formative and summative evaluations of the instructional design product. Prerequisite: IDT 500 SP

IDT/CED 535 Instructional Games and Simulations (3 credits)
Provides and in-depth study of the theoretical and practical issues surrounding the use of games and simulations in learning environments. Methods and approaches for integrating existing games into learning environments and for developing new simulations and games around content will be researched, evaluated and developed. SP

IDT/CED 573 Multimedia, Graphic and Web Design for Instruction (3 credits)
Emphasizes design elements, principles, development, and strategies used to produce effective multimedia presentations, quality websites, and original graphics. Students will use current Web 2.0 tools, presentation and video screen capturing software and other available applications to create quality productions for instructional and personal use. SP

IDT 590 Current Topics in Instructional Design and Technology (3 credits)
Examines some of the current topics in IDT such as Accessibility and Universal Design, Learning Environments, and Project Management. Students will analyze issues affecting current and future implementations of instructional design. Current research on topics of IDT will be emphasized. SU

IDT/CED 595 Culminating Project and Capstone Portfolio (3 credits)
This course consists of two main parts: 1. Extends students’ knowledge of the instructional applications of computing and technology. Research into current curriculum theory and development will be the basis for modeling educational activities that enhance instruction. Based on all previous coursework, students will determine the applications that can be used to design specific learning activities. 2. Provides a framework for students to compile a Capstone Portfolio that will consist of three major components. The portfolio will demonstrate the student’s over-all knowledge, abilities, and progress throughout the master’s degree process as well as a personal reflection essay and an assessment of the Masters’ program in Learning Technologies or Instructional Design and Technology. FA, SP, SU