1993

Graduate Catalog Center for Computer and Information Sciences

Nova Southeastern University

NOVA UNIVERSITY

Graduate Catalog

Center for Computer and Information Sciences

1993-1994

Oct. 5, 1993

THE UNIVERSITY

Nova University is a fully accredited, independent institution in its third decade of operation. The University offers courses of study leading to the bachelor's, master's, educational specialist, and doctoral degrees in a variety of fields. Nova's graduate programs are offered through centers that provide concentrations in business and entrepreneurship, computer and information sciences, education, law, oceanography, psychology, social and systemic studies, and humanities and arts. The law center is accredited by the American Bar Association and the Association of American Law Schools, and the psychology center is accredited by the American Psychological Association. In addition, Nova College offers undergraduate education, and the University School, a demonstration school, serves children from preschool through high school. Currently there are more than 11,000 students enrolled throughout all programs and more than 33,000 Nova graduates who work and contribute with distinction to their businesses and professions worldwide. From its beginning, the University has distinguished itself by its innovative outlook, its unique programs that provide both traditional and nontraditional choices in educational programs, and its research in many fields. Nova University's centers and programs share a common mission--to educate students for leadership roles in a variety of professions. Students develop a sense of professional ethics and responsibility and learn to appreciate the role of the professional as a key individual in society.

Nova's programs stress the critical relationship between theory and practice; they reinforce and test classroom learning with applied research and industrial practice to provide an expanded academic experience. The university extends its programs and resources to provide educational opportunities to working professionals nationwide. Many of these programs are enhanced through a variety of technologies, including telecommunications.

Through its educational offerings, research projects, and programs of public service, the University encourages the free exchange of ideas and the search for knowledge that is the cornerstone of the academic tradition.

Accreditation

Nova University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor's, master's, educational specialist, and doctoral degrees. Nova University admits students of any race, sex, age, color, nondisqualifying handicap, religion or creed, national or ethnic origin.

THE CENTER FOR COMPUTER AND INFORMATION SCIENCES

Nova's Center for Computer and Information Sciences (CCIS) has become a major force in educational innovation. It is distinguished by its ability to offer both traditional and nontraditional choices in educational programs and formats that enable the professional to pursue an advanced degree without career interruption.

Consistent with Nova's philosophy and mission, programs of the Center are designed to provide breadth and depth of knowledge as the basis for a quality education that keeps pace with rapidly changing professional and academic needs. Research activities stress a blend of theory and practice in an applied setting. Today, CCIS faculty and staff serve the educational needs of undergraduate and graduate students throughout the United States via a range of programs and specializations. Degrees offered by the Center include the B.S., M.S., Ph.D., Ed.D., and Sc.D.

CCIS Graduate Program Offerings

Master's Degree Programs

Computer Information Systems (M.S.)
Computer Science (M.S.)
Computing Technology in Education (M.S.)
- Specializations:
  - *Computer Education*
  - *Training and Learning*

Management Information Systems (M.S.)

Doctoral Degree Programs

Computer Information Systems (Ph.D. or Sc.D.)
Computer Science (Ph.D. or Sc.D.)
Computing Technology in Education (Ph.D., Ed.D., or Sc.D.)
- Specializations:
  - *Computer Education*
  - *Computing Systems in Education*
  - *Training and Learning*

Information Systems and Science (Ph.D. or Sc.D.)
- Specializations:
  - *Information Systems*
  - *Information Science*

For information about these programs call, send an e-mail message or write to CCIS:

Write: 3301 College Avenue, Fort Lauderdale, Florida 33314

Phone: 1-800-986-2247 305-475-7352

E-mail: ccisinfo@alpha.acast.nova.edu

For online catalogs, send an e-mail message to cciscat@alpha.acast.nova.edu. This system is automated. Information can also be retrieved by "finger" cciscat@alpha.acast.nova.edu via the UNIX system.

MASTER OF SCIENCE PROGRAMS

The Center for Computer and Information Sciences offers master's degree programs in:

- Computer Information Systems
- Computer Science
- Computing Technology in Education
  Specializations:
  Computer Education
  Training and Learning
- Management Information Systems

Programs are designed to give students a thorough knowledge of their fields of interest through course work, basic and applied research activities, and specialized projects. They blend theory and practice into a learning experience that develops skills applicable to complex real-world problems. Their formats offer professionals the opportunity to earn the master's degree in 18 or 24 months while continuing to work in their current positions.

Separate sections on each program contain curriculum details and format options. Admission requirements and general information for all master's degree programs are covered in a separate section. General information and academic information common to all graduate programs can be found in sections following the descriptions of the doctoral programs. Course descriptions for each area are contained in a single section near the end of the catalog.

Combined Master's/Doctoral Degree Option
For each master's degree program, the Center offers a combined master's and doctoral option which provides the opportunity to earn the doctoral degree in a shorter time. The student interested in this option must first be accepted in a master of science program that is compatible with the doctoral degree they seek. (Information on compatibilities can be obtained from Program Directors.)

Once students have completed eight courses (24 credits) in the master's program with a grade point average of at least 3.25, they may be accepted into the doctoral program. (Students must also fulfill all other doctoral admissions requirements). Upon acceptance into the doctoral program and after completion of 12 credits in the doctoral program, the student is awarded the master of science degree. These 12 credits also count toward the doctoral degree, thereby reducing the total time and cost to acquire it.

Master's Thesis Option
The master's student also has the option to complete a master's thesis. For the thesis option, the student must complete 30 semester hours of course work and/or projects and six semester hours for a written thesis. For the nonthesis option, 36 semester hours of course work and/or project courses are required.

M.S. PROGRAM IN COMPUTER INFORMATION SYSTEMS

The curriculum is consistent with recommendations for a model curriculum in computer information systems as outlined by the Association of Computing Machinery (ACM). Current areas of specialization in computer information systems include the structure of computer information systems, computer-communication networks, human-computer interaction, decision support systems, database systems, systems analysis and design, artificial intelligence and expert systems, and the management of information system projects and resources.

Program Formats

This 36-semester-hour program, consisting of 12 courses, is designed so it can be completed in as few as 18 months or 24 months, depending on format. The following formats are offered: on-campus in the evening, weekend *cluster* format (offered at North Florida sites and in Fort Lauderdale), quarterly *cluster* format (meetings in Fort Lauderdale) and combined *institute* and computer-based format. The course structures are:

on-campus format:	9 core courses and 3 electives
cluster format--18 months:	12 core courses
cluster format--24 months:	8 core courses and 4 projects
institute/computer-based format:	12 core courses

These formats are described in the following paragraphs.

On-Campus Format

This format operates on a 12-week term; four terms are offered each year. To complete the program in 18 months, the student must enroll in two courses per term. Each three-credit course meets for three hours per week for 12 weeks. Courses in the program are scheduled on campus in the evening. Students must complete nine core courses and three electives. Two core courses and at least two electives are offered per term.

Cluster Formats

Florida Cluster Sites (18-month format)

The program is offered in four Florida locations: Orlando, Tampa, Jacksonville, and Fort Lauderdale. Students attend two weekends per term per course on Friday evening, and all day Saturday and Sunday. The program consists of 12 core courses which may be completed in 18 months when students enroll for two courses per term. Students are expected to maintain this course load with their designated cluster group.

Fort Lauderdale Cluster (Two-year format)

The program can also be taken in Fort Lauderdale by attending courses four times per year on-campus on weekends (Friday, Saturday, and half-day Sunday). Students register for one course per term (eight core courses) and complete four projects to complete the degree within a two-year period.

Combined Institute and Computer-Based Format

This format requires the completion of 12 core courses, including attendance at two *institutes*. *Institutes* are week-long meetings, normally held in July and January in Fort Lauderdale, Florida that bring together students, faculty, staff, and nationally recognized lecturers for participation in courses, workshops, training, and discussions. The computer-based portion involves participation in a range of activities that facilitate frequent interaction with faculty, classmates, and colleagues including Nova's real-time electronic classroom

sessions, online computer discussions and conferences, electronic submission of assignments for review by faculty, electronic-mail communications, Nova's electronic library and off-campus library services, Nova's information retrieval service, and online academic counseling sessions. The Internet is used extensively for these communications and for student research. Costs for institutes and computer-based activities are included in the tuition. Lodging and travel expenses related to the institutes, however, are the responsibility of the student.

Curricula

The nine core courses for the on-campus format are:

MCIS 610 Data and File Structures
MCIS 620 Structure of CIS
MCIS 621 Management of IS Projects
MCIS 630 Database Systems
MCIS 650 Computer Networks
MCIS 651 Telecommunications
MCIS 660 Information Systems Analysis
MCIS 671 Decision Support Systems
MCIS 680 Human-Computer Interaction

Electives for the on-campus format are:

MCIS 622 Office Automation Systems
MCIS 623 Legal and Ethical Aspects of Computing
MCIS 624 Computer Integrated Manufacturing
MCIS 625 Computer Graphics for Information Managers
MCIS 631 Database Systems Practicum
MCIS 632 Distributed Database Management Systems
MCIS 640 System Test and Evaluation
MCIS 652 Computer Security
MCIS 654 Applications of the Internet
MCIS 670 Artificial Intelligence and Expert Systems
MCIS 672 Computer-Aided Software Engineering
MCIS 682 Information Systems Project
MCIS 683 Data Center Management
MCIS 691 Special Topics in Computer Information Systems

The 12 core courses for the 18-month cluster format and the institute/ computer-based format are:

MCIS 610 Data and File Structures
MCIS 620 Structure of CIS
MCIS 621 Management of IS Projects
MCIS 630 Database Systems
MCIS 640 System Test and Evaluation
MCIS 650 Computer Networks
MCIS 651 Telecommunications
MCIS 660 Information Systems Analysis
MCIS 670 Artificial Intelligence and Expert Systems
MCIS 671 Decision Support Systems
MCIS 680 Human-Computer Interaction
MCIS 690 System Design & Implementation

The eight core courses for the 24-month cluster format are:

MCIS 620 Structure of CIS
MCIS 621 Management of IS Projects
MCIS 630 Database Systems
MCIS 650 Computer Networks
MCIS 651 Telecommunications
MCIS 660 Information Systems Analysis
MCIS 671 Decision Support Systems
MCIS 680 Human-Computer Interaction

M.S. PROGRAM IN COMPUTER SCIENCE

The curriculum is consistent with recommendations for a model curriculum in computer science as outlined by the Association of Computing Machinery (ACM). Current areas of specialization include programming languages, operating systems, computer-communication networks, software engineering, database management systems, artificial intelligence, computer system architecture, and the theory of computation.

Program Formats

The 36-semester-hour program, consisting of 12 courses, is designed so it can be completed in as few as 18 months or 24 months, depending on format. The following formats are offered: on-campus in the evening, weekend *cluster* format (offered at North Florida sites and in Fort Lauderdale), and quarterly *cluster* format (meetings in Fort Lauderdale). The course structures listed below are described in the following paragraphs:

on-campus format:	9 core courses and 3 electives
cluster format--18 months:	12 core courses
cluster format--24 months:	8 core courses and 4 projects

On-Campus Format

This format operates on a 12-week term; four terms are offered each year. To complete the program in 18 months, the student must enroll in two courses per term. Each three-credit course meets for three hours per week for 12 weeks. Courses in the program are scheduled on campus in the evening. Students must complete nine core courses and three electives. Two core courses and at least two electives are offered per term.

Cluster Formats

Florida Cluster Sites (18-month format)

The program is offered in four Florida locations: Orlando, Tampa, Jacksonville, and Fort Lauderdale. Students attend two weekends per term per course on Friday evening, and all day Saturday and Sunday. The program consists of 12 core courses which may be completed in 18 months when students enroll for two courses per term. Students are expected to maintain this course load with their designated cluster group.

Fort Lauderdale Cluster (Two-year format)

The program can also be taken in Fort Lauderdale by attending courses four times per year on-campus on weekends (Friday, Saturday, and half-day Sunday). Students register for one course per term (eight core courses) and complete four projects to earn the degree within a two-year period.

Curricula

The nine core courses for the on-campus format are:

CISC 610 Programming Languages
CISC 615 Design/Analysis of Algorithms
CISC 630 Compiler Design Theory
CISC 640 Operating Systems
CISC 647 Advanced Computer Architecture
CISC 651 Data/Computer Communications
CISC 660 Database Management Systems
CISC 670 Artificial Intelligence
CISC 680 Software Engineering

Electives for the on-campus format are:

CISC 612 Concurrent Programming Languages.
CISC 620 Modeling and Simulation
CISC 622 Numerical Analysis
CISC 631 Language Theory and Automata
CISC 632 Compiler Implementation
CISC 634 Complexity Theory
CISC 643 Array Processors and Supercomputers
CISC 644 Operating Systems Implementation
CISC 645 Microprogramming and Microprocessors
CISC 646 Distributed Computing Systems
CISC 650 Network Design and Analysis
CISC 661 Database Management Systems Practicum
CISC 662 Distributed Databases
CISC 663 Object-Oriented Database Systems
CISC 671 Robotics
CISC 681 Interactive Computer Graphics
CISC 682 Software Engineering Implementation
CISC 683 Object-Oriented Design
CISC 690 Special Topics

The 12 core courses for the 18-month cluster format are:

CISC 610 Programming Languages
CISC 615 Design/Analysis of Algorithms
CISC 620 Modeling and Simulation
CISC 630 Compiler Design Theory
CISC 640 Operating Systems
CISC 647 Advanced Computer Architecture
CISC 651 Data/Computer Communications
CISC 660 Database Management Systems
CISC 670 Artificial Intelligence
CISC 680 Software Engineering
CISC 681 Interactive Computer Graphics
CISC 683 Object-Oriented Design

The eight core courses for the 24-month cluster format are:

CISC 615 Design/Analysis of Algorithms
CISC 630 Compiler Design Theory
CISC 640 Operating Systems
CISC 647 Advanced Computer Architecture
CISC 651 Data/Computer Communications
CISC 660 Database Management Systems
CISC 670 Artificial Intelligence
CISC 680 Software Engineering

M.S. PROGRAM IN COMPUTING TECHNOLOGY IN EDUCATION

This program offers a course of study leading to the degree of Master of Science in Computing Technology in Education with specializations in *Computer Education* and *Training and Learning*.

It is designed to meet the needs of working professionals such as teachers, educational administrators, and trainers working in both public and private sectors. The program blends educational theory and practice into a learning experience that develops skills applicable to complex real-world problems.

The program format combines traditional and nontraditional instruction to give professionals the opportunity to earn the master's degree in 18 months while continuing to work in their current positions. Students sit for instruction at an *institute* held at the university. They also participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues including Nova's real-time Electronic Classroom sessions, online computer discussions and conferences, electronic submission of assignments for review by faculty, electronic-mail communications, Nova's electronic library and off-campus library services, Nova's information retrieval service, and online academic advisement sessions. The Internet is also used extensively for communications and student research.

Specialization in Computer Education (CED)

This specialization is designed for teachers who use computers in their classrooms. It will enhance knowledge of how computing machinery and other forms of high technology can be used to improve learning outcomes and prepare students for roles in societies characterized by constantly changing information paradigms. The 12-course curriculum includes:

MCTE 610 Structured Programming in Pascal and Logo
MCTE 615 Online Information Systems
MCTE 620 Computer Literacy and Educational Reform
MCTE 625 Survey of Courseware
MCTE 626 Authoring Systems Design
MCTE 630 Database Systems
MCTE 640 Computing Technology Facilities Planning
MCTE 650 Computer Communications
MCTE 660 Multimedia and Emerging Technologies
MCTE 670 Learning Theory and Computer Applications
MCTE 680 Human-Computer Interaction
MCTE 680 Computer-Based Statistics

Specialization in Training and Learning (TL)

This specialization is designed for the needs of trainers who are working with advanced computer and instructional technology. This specialization enables training professionals to meet their professional responsibilities while continuing to develop computer-based competencies that are needed in the training field. The 12-course curriculum includes:

MCTE 615 Online Information Systems
MCTE 625 Survey of Courseware
MCTE 626 Authoring Systems Design
MCTE 630 Database Systems
MCTE 640 Computing Technology Facilities Planning
MCTE 650 Computer Communications
MCTE 660 Multimedia and Emerging Technologies
MCTE 670 Learning Theory and Computer Applications
MCTE 680 Human-Computer Interaction
MCTE 680 Computer-Based Statistics
MCTE 698 Directed Study in Training and Learning I
MCTE 699 Directed Study in Training and Learning II

Program Format

This 36-semester-hour program, consisting of 12 courses in the selected specialization, is designed so that it can be completed in 18 months without interrupting the student's professional career. To complete the program in 18 months, the student must enroll in two courses per term. (Terms are 12 weeks in duration and there are four terms per year.) The program is offered in a combined *institute* and computer-based format. The *institute* is a week-long meeting, normally held in July in Fort Lauderdale, Florida that brings together students, faculty, staff, and nationally recognized lecturers for participation in courses, workshops, training, and discussions. The computer-based portion involves participation in a range of computer-mediated activities that facilitate frequent interaction with faculty, classmates, and colleagues. Online interactive learning methods and teleconferencing are used throughout the instructional sequence, allowing students the opportunity to complete courses without the need for regular evening class attendance or extensive travel away from home. Costs for the institute and computer-based activities are included as part of the student's tuition. Lodging and travel expenses related to the institute, however, are the responsibility of the student.

M. S. PROGRAM IN MANAGEMENT INFORMATION SYSTEMS

This graduate program offers a course of study leading to the degree of M.S. in Management Information Systems. It focuses on the application of information system concepts to the collection, retention, and dissemination of information for management planning and decision making. The program blends theory and practice into a learning experience that develops skills applicable to complex real-world problems. Its formats offer professionals the opportunity to earn the master's degree in 18 months while continuing to work in their current positions. The program is designed to give the student a thorough knowledge of the field through course work and specialized projects. Current areas of specialization in management information systems include decision support systems, systems analysis and design, database applications, organization of the computing environment, project management, telecommunications and computer networking, human-computer interaction, quantitative methods, and the application of microcomputer systems.

Program Formats

The 36-semester-hour program, consisting of 12 courses, is designed so it can be completed in as few as 18 months. There are currently two formats for this program, the on-campus format which requires nine core courses and three electives, and the institute/computer-based format which requires 12 core courses.

On-Campus Format

This format operates on a 12-week term; four terms are offered each year. To complete the program in 18 months, the student must enroll in two courses per term. Each three-credit course meets for three hours per week for 12 weeks. Courses in the program are scheduled on campus in the evening. Students must complete nine core courses and three electives.

Combined Institute and Computer-Based Format

This format requires the completion of 12 core courses, including attendance at two *institutes*. *Institutes* are week-long meetings, normally held in July and January in Fort Lauderdale, Florida that bring together students, faculty, staff, and nationally recognized lecturers for participation in courses, workshops, training, and discussions. The computer-based portion involves participation in a range of activities that facilitate frequent interaction with faculty, classmates, and colleagues including Nova's real-time electronic classroom sessions, online computer discussions and conferences, electronic submission of assignments for review by faculty, electronic-mail communications, Nova's electronic library and off-campus library services, Nova's information retrieval service, and online academic counseling sessions. The Internet is also used extensively. Costs for institutes and computer-based activities are included in the tuition. Lodging and travel expenses related to the institutes, however, are the responsibility of the student.

Curricula

The nine core courses for the on-campus format are:

- MMIS 620 Management Information Systems
- MMIS 621 Information Systems Project Management
- MMIS 630 Databases in MIS
- MMIS 641 Organization of the Computing Environment
- MMIS 653 Telecommunications and Computer Networking
- MMIS 660 Systems Analysis
- MMIS 671 Decision Support Systems
- MMIS 680 Human-Computer Interaction
- MMIS 690 Systems Design

Electives for the on-campus format are:

- MMIS 610 Survey of Computer Languages
- MMIS 615 Quantitative Methods
- MMIS 622 Office Automation Systems
- MMIS 623 Legal and Ethical Aspects of Computing
- MMIS 624 Computer Integrated Manufacturing
- MMIS 625 Computer Graphics for Information Managers
- MMIS 626 Application of Microcomputer Systems
- MMIS 631 Databases in MIS Practicum
- MMIS 632 Distributed Database Management
- MMIS 640 System Test and Evaluation
- MMIS 652 Computer Security
- MMIS 654 Applications of the Internet
- MMIS 670 Artificial Intelligence and Expert Systems
- MMIS 672 Computer-Aided Software Engineering
- MMIS 683 Data Center Management

The 12 core courses for the 18-month institute/ computer-based format are:

MMIS 610 Survey of Computer Languages
MMIS 615 Quantitative Methods
MMIS 620 Management Information Systems
MMIS 621 Information Systems Project Management
MMIS 626 Application of Microcomputer Systems
MMIS 630 Databases in MIS
MMIS 641 Organization of the Computing Environment
MMIS 653 Telecommunications and Computer Networking
MMIS 660 Systems Analysis
MMIS 671 Decision Support Systems
MMIS 680 Human-Computer Interaction
MMIS 690 Systems Design

ADMISSION REQUIREMENTS AND GENERAL INFORMATION FOR MASTER'S DEGREE PROGRAMS

Admission Requirements

Applicants for a master's degree program must meet the following requirements:

(1) The applicant must have a bachelor's degree from a regionally accredited college or university representing completion of course work that fulfills requirements for graduate work in the selected area. (See specific requirements delineated below for your program.)
(2) Official transcripts of all prior graduate and undergraduate work must be sent directly from the institution to:
Center for Computer and Information Sciences
Nova University
3301 College Avenue
Fort Lauderdale, FL 33314
(3) Have at least a 2.5 undergraduate G.P.A. and a 3.0 G.P.A. in the undergraduate major.
(4) Submit a completed application with application fee.
(5) Provide three letters of recommendation.
(6) Submit a G.R.E. score or portfolio with appropriate work experience and credentials.
(7) Meet the specific program requirements described in the paragraphs below.

Specific Requirements for Computer Science

Applicants should have an undergraduate major in computer science, engineering, mathematics, or physics and have completed courses or have equivalent experience in data structures, computer architecture, structured programming, systems software (compilers or operating systems), calculus (differential and integral calculus), and discrete mathematics.

Specific Requirements for Computer Information Systems

Applicants should have an undergraduate major in computer science, computer information systems, engineering, mathematics, or physics and have completed courses or have equivalent experience in data structures, structured programming, college algebra or higher, statistics, discrete mathematics, and familiarity with computer hardware and computer architecture.

Specific Requirements for Computing Technology in Education
The applicant should have a bachelor's degree in a related field from a regionally accredited institution plus experience with computer applications. If certified, applicants should submit copies of their teaching certificates. Also, applicants should complete a certification waiver* which is included with the application forms.

Specific Requirements for Management Information Systems
Applicants should have an undergraduate major in management information systems, computer information systems, business administration, or a related field and have knowledge and experience in computer applications and programming in a high-level language. Applicants for the on-campus format not having adequate programming experience will be required to take Survey of Computer Languages as one of their electives.

Prospective applicants who have not satisfied requirements for their selected program are advised to make up the appropriate deficiencies before applying to the graduate program. Prospective students may take foundation courses at Nova University or at any other regionally accredited institution. The CCIS program office will provide interested students with a list of recommended Nova undergraduate courses that would satisfy graduate admission requirements. Applicants must include official transcripts reflecting completion of such courses with their applications.

Application Submission
It is recommended that applications be submitted three months prior to the intended start date. For example, for the September term, students should start submitting paperwork before the end of June. Students submitting applications later than this are advised to contact the program office by telephone as soon as possible to make arrangements. Copies of transcripts are acceptable for unofficial early review.

Term Dates
Terms are 12 weeks in duration and there are four terms per year.

September (Fall)
January (Winter)
April (Spring)
July (Summer)

Master's Programs Tuition and Fees

Tuition	$280 per credit ($840 per course)
Application Fee	$40 non refundable
Registration Fee	$30 non refundable
Late Registration Surcharge	$30 non refundable
Graduation Fee	$50

Note: Tuition and fees are subject to change. Textbooks are not included and must be purchased by the student. Students are responsible for their own lodging and travel expenses. Students must be registered to gain access to Nova's computing services. Students not registered but needing faculty/computing services register for one credit of continuing services per term.

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* *Because of the national scope of the program and the uniqueness of the requirements of each state, satisfactory completion of the master's program does not guarantee that students will meet teaching certification requirements for their states.*

Transfer Policy

Up to six graduate credits may be transferred from a regionally accredited institution. Courses proposed for transfer must have received grades of at least "B". Students must request approval of transfer credits in writing. The transfer will be evaluated by the Admission Committee upon receipt of an official transcript from the institution originally granting the credit. Catalog course descriptions are also required.

Tuition Payment Policy

Tuition is due in full at the time of registration. Tuition and fees may be satisfied with payment by cash, check, money order, credit card, or financial aid as authorized on an individual's official award letter.

Students receiving tuition reimbursement from employers pay the University directly and request reimbursement from their companies as they complete their courses. If companies allow direct billing, the student must attach a letter from his/her employer to the registration form that formally requests that billing be made directly to the student's employer.

Change of Plans

If a student temporarily withdraws for a term, this will naturally extend the length of the program. Students attending a Florida cluster site may have to attend a different cluster site to attend the missed course. Special permission is required and the student will need to complete a student action request in order to take courses at other cluster locations. Students who miss a required institute must make up courses at a future institute.

Time Limitation

Students in a master's degree program are expected to complete requirements for the degree within five years from the date of their first registration.

DOCTORAL PROGRAMS

The Center for Computer and Information Sciences offers doctoral degree programs in:

- Computer Information Systems
- Computer Science
- Computing Technology in Education
  Specializations:
  Computer Education
  Computing Systems in Education
  Training and Learning
- Information Systems and Science
  Specializations:
  Information Systems
  Information Science

CCIS doctoral programs are designed to give students a thorough knowledge of their fields of interest through course work, basic and applied research activities, and specialized projects. They blend theory and practice into a learning experience that develops skills applicable to complex real-world problems. Their formats offer professionals the opportunity to earn the doctorate while continuing to work in their current positions.

Separate sections on each program contain curriculum details and format options. Admission requirements and general information for all doctoral degree programs are covered in a separate section. General information and academic information common to all graduate programs can be found in sections following the descriptions of the doctoral programs. Course descriptions for each area are contained in a single section near the end of the catalog.

Combined Master's/Doctoral Degree Option
For each master's degree program, the Center offers a combined master's and doctoral option which provides the opportunity to earn the doctoral degree in a shorter time. The student interested in this option must first be accepted in a master of science program that is compatible with the doctoral degree they seek. (Information on compatibilities can be obtained from Program Directors.)

Once students have completed eight courses (24 credits) in the master's program with a grade point average of at least 3.25, they may be accepted into the doctoral program. (Students must also fulfill all other doctoral admissions requirements).

Upon acceptance into the doctoral program and after completion of 12 credits in the doctoral program, the student is awarded the master of science degree. These 12 credits also count toward the doctoral degree, thereby reducing the total time and cost to acquire it.

DOCTORAL PROGRAM IN COMPUTER INFORMATION SYSTEMS

This program offers a course of study leading to the degree of Doctor of Philosophy (Ph.D.) or Doctor of Science (Sc.D.) in Computer Information Systems. It produces technology-oriented professionals with knowledge in major areas of computer information systems and the ability to develop creative solutions to substantive real-world system problems.

The format of this program gives professionals the opportunity to pursue a systematic plan of graduate study while continuing to work in their current positions. It is especially well-suited to professionals in business, government, industry, or education who are involved with research, design, implementation, management, evaluation, utilization, and teaching related to computer information systems. Courses, projects, and research activities under faculty guidance serve as an expanded learning environment.

The program requires 68-semester-hours of which 48 are required courses and projects and 20 are for the dissertation. It may be completed in four years (eight six-month semesters) but students have up to seven years to complete the program requirements.

The curriculum for this program requires courses and projects in these major areas:

DCIS 730/830 Structure of Computer Information Systems
DCIS 750/850 Database Management Systems
DCIS 740/840 Data Communications and Computer Networking
DCIS 710/810 Decision Support Systems
DCIS 720/820 Human-Computer Interaction
DCIS 770/870 Software Engineering
DCIS 780/880 Information Systems Analysis
DCIS 760/860 Artificial Intelligence and Expert Systems

Program Format

The doctoral program in Computer Information Systems operates on six-month semesters. Each student must complete eight core courses, six projects, and a dissertation. During the first three years of the program, the student completes six core courses and six projects. Each semester, one three-credit core course and its related four-credit project course are taken concurrently. Each course and project requires six months to complete. Each year, the student attends four cluster meetings at Nova University. (Clusters are described below.)

During the fourth year, the student completes two additional core courses and registers for the dissertation, which is the main focus of this year of study and the most important requirement for the doctoral degree. Each student is expected, with the help and approval of an advisor, to select an appropriate topic of sufficient scope to satisfy this requirement. Students should produce results that advance knowledge and improve professional practice in the field of computer information systems. Even though students do not register for the dissertation until the fourth year, they are encouraged to start working with faculty on their dissertations as early in the program as possible. (For further information on the dissertation see the general section.) Students who do not complete the dissertation within the four-year program register for continuing dissertation services until the dissertation is completed.

Cluster meetings are held quarterly, each on an extended weekend (Friday, Saturday, and half-day Sunday). These meetings bring together students, faculty, staff, and nationally recognized lecturers for participation in lectures, discussions, and dissertation counseling. Courses are taught during these meetings by a renowned faculty and distinguished computer information systems professionals.

In the months between cluster meetings, students study the course material, complete assignments, read the literature, prepare project proposals, complete research papers and/or applied research projects, and participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues. Computer-based activities include electronic-mail communications, teleconferences, Nova's electronic library, and Nova's information retrieval service. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.Costs for cluster meetings and related computer-based activities are included as part of the student's tuition. Lodging and travel expenses related to cluster meetings, however, are the responsibility of the student.

Students may begin the program at the start of any six-month semester. A sample schedule is shown below for students who start in Fall 1993. Students starting later than this can expect the courses to recycle.

Schedule for Computer Information Systems Doctoral Students Starting in Fall 1993

Year	Fall Semester	Year	Spring Semester
1993	Decision Support Systems Course: 3 credits Project 1: 4 credits	1994	Database Management Systems Course: 3 credits Project 2: 4 credits
1994	Artificial Intelligence and E.S. Course: 3 credits Project 3: 4 credits	1995	Information Systems Analysis Course: 3 credits Project 4: 4 credits
1995	Human-Computer Interaction Course: 3 credits Project 5: 4 credits	1996	Str. of Computer Info. Systems Course: 3 credits Project 6: 4 credits
1996	Software Engineering Course: 3 credits Dissertation: 10 credits	1997	Data Comm. & Comp. Networking Course: 3 credits Dissertation: 10 credits

Cluster Meeting Dates for 1993 and 1994:

September 10,11,12, 1993 (start Fall semester)
December 3,4,5, 1993
March 4,5,6, 1994 (end Fall semester and start Spring semester)
June 3,4,5, 1994
September 9,10,11, 1994 (end spring semester and start Fall semester)
December 2,3,4, 1994

NOTE: In the above schedule, no projects are shown for the last two courses, however, students are free to select any six of the eight subject areas for their projects.

DOCTORAL PROGRAM IN COMPUTER SCIENCE

This program offers a course of study leading to the degree of Doctor of Philosophy (Ph.D.) or Doctor of Science (Sc.D.) in Computer Science. This program produces research-oriented professionals with knowledge in the major areas of computer science and the ability to develop creative solutions to substantive real-world problems.

The format of this program gives professionals the opportunity to pursue a systematic plan of graduate study while continuing to work in their current positions. It is especially well-suited to professionals in industry, education, or government who are involved with one of the many areas of computer science. Courses, specialized projects, and research activities under faculty guidance serve as an expanded learning environment.

The program requires 68-semester-hours of which 48 are required courses and projects and 20 are for the dissertation. It may be completed in four years (eight six-month semesters) but students have up to seven years to complete the program requirements.

The curriculum for this program requires courses and projects in these major areas:

CISD 700/800 Theory and Principles of Programming
CISD 770/870 Software Engineering
CISD 710/810 Modeling and Simulation
CISD 750/850 Database Management Systems
CISD 740/840 Data Communications and Computer Networking
CISD 760/860 Artificial Intelligence
CISD 720/820 Compilers, Language Theory, and Automata
CISD 730/830 Operating Systems

Program Format

This program operates on six-month semesters. Each student must complete eight core courses, six projects, and a dissertation. During the first three years, the student completes six core courses and six projects. Each semester, one three-credit core course and its related four-credit project course are taken concurrently. Each course and project requires six months to complete. Each year, the student attends four cluster meetings at Nova University. (Cluster meetings are described below.)

During the fourth year, the student completes two additional core courses and registers for the dissertation, which is the main focus of this year of study and the most important requirement for the doctoral degree. Each student is expected, with the help and approval of an advisor, to select an appropriate topic of sufficient scope to satisfy this requirement. Students should produce results that advance knowledge and improve professional practice in the field of computer science.

Even though students do not register for the dissertation until the fourth year, they are encouraged to start working with faculty on their dissertations as early in the program as possible. (For further information, see the separate section on the dissertation.) Students who do not complete the dissertation within the four-year program register for continuing dissertation services until the dissertation is completed.

Cluster meetings are held quarterly, each on an extended weekend (Friday, Saturday, and half-day Sunday). These meetings bring together students, faculty, staff, and nationally recognized lecturers for participation in lectures, discussions and dissertation counseling. Courses are taught during these meetings by a renowned faculty and distinguished computer science professionals.

In the months between cluster meetings, students study the course material, complete assignments, read the literature, prepare project proposals, complete research papers and/or applied research projects, and participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues.

Computer-based activities include electronic-mail communications, teleconferences, Nova's electronic library, and Nova's information retrieval service. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.

Costs for cluster meetings and related computer-based activities are included as part of the student's tuition. Lodging and travel expenses related to cluster meetings, however, are the responsibility of the student.

Students may begin the program at the start of any six-month semester. A sample schedule is shown on the next page for students who start in Fall 1993. Students starting later than this can expect the courses to recycle.

Schedule for Computer Science Doctoral Students
Starting in Fall 1993

Year*	Fall Courses	Year*	Spring Courses
1993	Modeling, Simulation, and Mathematical Programming Course: 3 credits Project: 4 credits	1994	Theory and Principles of Programming Course: 3 credits Project: 4 credits
1994	Artificial Intelligence and Expert Systems Course: 3 credits Project: 4 credits	1995	Database Management Systems Course: 3 credits Project: 4 credits
1995	Operating Systems Course: 3 credits Project: 4 credits	1996	Software Engineering Course: 3 credits Project: 4 credits
1996	Compilers, Language Theory, and Automata Course: 3 credits	1997	Data Communications and Computer Networking Course: 3 credits
	Dissertation: 10 credits		Dissertation: 10 credits

Cluster Meeting Dates for 1993 and 1994:

September 10,11,12, 1993 (start Fall semester)
December 3,4,5, 1993
March 4,5,6, 1994 (end Fall semester and start Spring semester)
June 3,4,5, 1994
September 9,10,11, 1994 (end spring semester and start Fall semester)
December 2,3,4, 1994

NOTE: In the above schedule, no projects are shown for the last two courses, however, students are free to select any six of the eight subject areas for their projects.

DOCTORAL PROGRAM IN COMPUTING TECHNOLOGY IN EDUCATION

The Doctoral Program in Computing Technology in Education has three areas of specialization, each with the opportunity to earn the Ph.D., Ed.D., or Sc.D. degree. The program specializations are:

- Computer Education
- Computing Systems in Education
- Training and Learning

The program is designed to meet the specific needs of working professionals in education and training including teachers, professors, educational administrators, educational systems administrators, and trainers working in both public and private sectors. Throughout the program, educational theory, research, and practice are blended into a learning experience that develops skills applicable to complex real-world problems. Courses, specialized projects, and research activities under faculty guidance serve as an expanded learning environment.

The program formats, through a blend of traditional and nontraditional instruction, give professionals the opportunity to pursue a systematic plan of graduate study while continuing to work in their current positions. Students sit for instruction at quarterly cluster meetings or twice-yearly institutes. They also participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues including Nova's real-time Electronic Classroom sessions, online real-time computer discussions and conferences, electronic submission of completed assignments for review by faculty, electronic-mail communications, Nova's electronic library, Nova's information retrieval service, and online academic advisement sessions. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.

During the first two years of the program, the student completes seven or eight core courses (depending on specialization) and four projects. Either the *major applied research project* (MARP) or the *dissertation* is the focus of the third year of this planned three-year program. (See the general section for additional information on the dissertation and the MARP.)

Schedules are shown on the following pages for the specialization areas for students that start in January 1994, however, students may begin the program at the start of any six-month semester.

While the schedules show registrations for dissertation/MARP in the third year, students are encouraged to start working with faculty on these activities whenever feasible during the three-year schedule. Students are free to select any four of the subject areas in which to do projects (but computer education students must do the project in research and statistics).

Students who do not complete the dissertation/MARP within the three-year program register for continuing dissertation/MARP services until the dissertation/MARP is completed.

Specialization in Computer Education (CED)

This specialization is designed for educators at all levels and concentrates on the use of computers and other forms of advanced technology to improve cognition. Computers have become pervasive in the educational process, making this specialization of interest to educators in disciplines outside of computer science, for example: English, mathematics, history and the social sciences, biology, and chemistry. Educational administrators would also benefit from this program, since administration and decision-making rely heavily on computing technology. The curriculum for this specialization is as follows:

DCTE 735/835 Application of Authoring Systems to Curriculum Design
DCTE 747/847 Computer Application of Learning Theory
DCTE 710/810 Computer-based Research and Statistics
DCTE 720/820 Human-Computer Interaction
DCTE 745/845 Multimedia and Emerging Technologies
DCTE 770/870 Courseware and Educational Programming Languages
DCTE 740/840 Telecommunications and Computer Networks

Schedule for Computer Education Doctoral Students Starting in January 1994

			TOTAL
YEAR ONE			
January 1994	Authoring Systems	3 credits	
	Learning Theory	3 credits	
	Project 1	4 credits	10 credits
July 1994	Research & Statistics	3 credits	
	Project 2 (res/stat)	4 credits	7 credits
YEAR TWO			
January 1995	Human-Computer Interaction	3 credits	
	Multimedia & Emerging Tech.	3 credits	
	Project 3	4 credits	10 credits
July 1995	Courseware &Programming	3 credits	
	Telecommunications/Networks	3 credits	
	Project 4	4 credits	10 credits
YEAR THREE			
January 1996	Dissertation/MARP	12 credits	12 credits
July 1996	Dissertation/MARP	12 credits	12 credits
			61 credits

Specialization in Computing Systems in Education (CSE)

This specialization is designed for educators at all levels and concentrates on the development, production, implementation, management, and evaluation of computing systems that support the educational process. It is designed to meet the needs of systems administrators working in an educational environment. Educational professionals would also be interested in this program due to the increasing dominance of local area networks and multimedia platforms in American education. This specialization concentrates on the following study areas:

DCTE 795/895 Telecommunications
DCTE 790/890 Computer Networks
DCTE 760/860 Artificial Intelligence and Expert Systems
DCTE 715/815 Management of Computing Resources
DCTE 745/845 Multimedia and Emerging Technologies
DCTE 720/820 Human-Computer Interaction
DCTE 765/865 Systems Analysis for Instructional Computing Systems
DCTE 750/850 Applied Database Management System

Schedule for CSE Doctoral Students
Starting in January 1994

			TOTAL
YEAR ONE			
January 1994	Telecommunications	3 credits	
	Computer Networks	3 credits	
	Project 1	4 credits	10 credits
July 1994	AI & Expert Systems	3 credits	
	Mgt. of Computing Resources	3 credits	
	Project 2	4 credits	10 credits
YEAR TWO			
January 1995	Human-Computer Interaction	3 credits	
	Multimedia & Emerging Tech.	3 credits	
	Project 3	4 credits	10 credits
July 1995	Systems Analysis	3 credits	
	Applied DBMS	3 credits	
	Project 4	4 credits	10 credits
YEAR THREE			
January 1996	Dissertation/MARP	12 credits	12 credits
July 1996	Dissertation/MARP	12 credits	12 credits
			64 credits

Specialization in Training and Learning (TL)

This specialization addresses the role of computing and other forms of high technology in training processes in the commercial/industrial setting. Training and learning has increased in importance as organizations rely increasingly on training departments to continually educate employees to take advantage of rapid developments in technology. Computer-based training methods offer an effective means to accommodate technological growth and increase the productivity of employees. This specialization concentrates on the following areas:

DCTE 735/835 Application of Authoring Systems to Curriculum Design
DCTE 747/847 Computer Application of Learning Theory
DCTE 760/860 Artificial Intelligence and Expert Systems
DCTE 715/815 Management of Computing Resources
DCTE 720/820 Human-Computer Interaction
DCTE 745/845 Multimedia and Emerging Technologies
DCTE 770/870 Courseware and Educational Programming Languages
DCTE 740/840 Telecommunications and Computer Networks

Schedule for Training & Learning Doctoral Students Starting in January 1994

			TOTAL
YEAR ONE			
January 1994	Authoring Systems	3 credits	
	Learning Theory	3 credits	
	Project 1	4 credits	10 credits
July 1994	AI & Expert Systems	3 credits	
	Mgt of Computing Resources	3 credits	
	Project 2	4 credits	10 credits
YEAR TWO			
January 1995	Human-Computer Interaction	3 credits	
	Multimedia & Emerging Tech.	3 credits	
	Project 3	4 credits	10 credits
July 1995	Telecom./Computer Networks	3 credits	
	Courseware & Programming	3 credits	
	Project 4	4 credits	10 credits
YEAR THREE			
January 1996	Dissertation/MARP	12 credits	12 credits
July 1996	Dissertation/MARP	12 credits	12 credits
			64 credits

Program Format

This program contains six semesters, with each semester lasting six months. It is designed so that it can be completed in three years without interrupting the student's professional career. This program combines a carefully balanced mixture of traditional and nontraditional instruction. The student chooses one of two formats: *cluster* or *institute*. Each format includes group meetings and computer-based activities.

Students choosing the *cluster format* attend four cluster meetings per year. Cluster meetings are held quarterly over an extended weekend (Friday, Saturday, and half-day Sunday), at Nova University in Fort Lauderdale, Florida. Students choosing the *institute format* attend institutes twice a year at Nova University in Fort Lauderdale, Florida. Institutes are week-long meetings, usually held in January and July.

Cluster and institute meetings bring together students, faculty, staff, and nationally recognized lecturers for participation in lectures, workshops, training, discussions, and dissertation/MARP counseling. Courses are taught during these meetings by a renowned faculty and distinguished professionals.

In the months between meetings, students study the course material, complete assignments, read the literature, prepare project proposals, complete research papers and applied research projects, and participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues.

Computer-based activities include Nova's real-time Electronic Classroom sessions, online real-time computer discussions and conferences, electronic submission of completed assignments for review by faculty, electronic-mail communications, Nova's electronic library, Nova's information retrieval service, and online academic advisement sessions. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.

Costs for clusters, institutes and computer-based activities are included as part of the student's tuition. Lodging and travel expenses related to clusters and institutes, however, are the responsibility of the student.

DOCTORAL PROGRAM IN INFORMATION SYSTEMS AND SCIENCE

The Doctoral Program in Information Systems and Science has two areas of specialization, each with the opportunity to earn the Ph.D., or Sc.D. degree. The program produces technology-oriented professionals with the knowledge and ability to develop creative solutions to substantive real-world problems. The program specializations are:

- Information Systems (IS)
- Information Science (ISc)

Formats of the program provide professionals working in business, government, industry, or education with the opportunity to pursue a systematic plan of graduate study while continuing to work in their current positions. Courses, specialized projects, and research activities under faculty guidance serve as an expanded learning environment.

This program combines a carefully balanced mixture of traditional and nontraditional instruction. Students sit for instruction at quarterly cluster meetings or twice-yearly institutes. Students also participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues including Nova's real-time Electronic Classroom sessions, online real-time computer discussions and conferences, electronic submission of completed assignments for review by faculty, electronic-mail communications, Nova's electronic library, Nova's information retrieval service, and online academic advisement sessions. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.

The program requires 64-semester-hours of which 40 are required courses and projects and 24 are for the dissertation. It may be completed in three years (six semesters, with each semester lasting six months) without interrupting the student's professional career. (Students have up to seven years to complete the program requirements.)

During the first two years, the student completes eight core courses and four projects. The dissertation is the focus of the third year of this planned three-year program. (See the general section for additional information on the dissertation.)

Schedules are shown on the following pages for the specialization areas for students that start in January 1994, however, students may begin the program at the start of any six-month semester.

While the schedules show registration for the dissertation in the third year, students are encouraged to start working with faculty on these activities whenever feasible during the three-year schedule. Students are free to select any four of the subject areas in which to do projects.

Students who do not complete the dissertation within the three-year program register for continuing dissertation services until the dissertation is completed.

Specialization in Information Systems (IS)

This specialization is intended for professionals who work in the areas such as software engineering, information system planning, systems analysis and design, project management, and information system administration. Information systems play a prominent role in the growth and restructuring of American industry to take advantage of new and rapidly evolving developments in technology. It is expected that information systems will remain a growth area in terms of employment and professional opportunities. The curriculum for this specialization is listed below:

DISS 750/850	Applied Database Management Systems
DISS 740/840	Computer Networks and Telecommunications
DISS 710/810	Decision Support Systems
DISS 720/820	Human-Computer Interaction
DISS 730/830	Information Systems Structure
DISS 780/880	Information Systems Analysis
DISS 760/860	System Design, Test, and Evaluation
DISS 715/815	Management of Computing Resources

Schedule for Information Systems Doctoral Students Starting in Winter 1994

			TOTALS
YEAR ONE			
January 1994	Decision Support Systems	3 credits	
	Mgt. of Computing Resources	3 credits	
	Project 1	4 credits	10 credits
July 1994	Information Systems Analysis	3 credits	
	Computer Networks/Telecom.	3 credits	
	Project 2	4 credits	10 credits
YEAR TWO			
January 1995	Human-Computer Interaction	3 credits	
	Information Systems Structure	3 credits	
	Project 3	4 credits	10 credits
July 1995	Applied DBMS	3 credits	
	Syst. Design, Test, and Eval.	3 credits	
	Project 4	4 credits	10 credits
YEAR THREE			
January 1996	Dissertation	12 credits	12 credits
July 1996	Dissertation	12 credits	12 credits
			64 credits

Specialization in Information Science (ISc)

This specialization is intended for professionals who are employed in a library or information center environment. Information organization and retrieval have evolved into issues of enormous importance in light of the continued rapid developments in computing technology. The professionals who can mange information in an efficient manner are in an excellent position in terms of employment and professional opportunities. The curriculum for this specialization is listed below:

DISS 750/850	Applied Database Management Systems
DISS 790/890	Computer Networks
DISS 720/820	Human-Computer Interaction
DISS 715/815	Management of Computing Resources
DISS 795/895	Telecommunications
DISS 725/825	Structure of Library Information Systems
DISS 735/835	Technology-Based Cataloging
DISS 745/845	Multimedia and Emerging Technologies

Schedule for Information Science Doctoral Students Starting in Winter 1994

			TOTAL
YEAR ONE			
January 1994	Telecommunications	3 credits	
	Computer Networks	3 credits	
	Project 1	4 credits	10 credits
July 1994	Structure of Library Info. Systs.	3 credits	
	Mgt. of Computing Resources	3 credits	
	Project 2	4 credits	10 credits
YEAR TWO			
January 1995	Human-Computer Interaction	3 credits	
	Multimedia & Emerging Tech.	3 credits	
	Project 3	4 credits	10 credits
July 1995	Applied DBMS	3 credits	
	Technology-Based Cataloging	3 credits	
	Project 4	4 credits	10 credits
YEAR THREE			
January 1996	Dissertation	12 credits	12 credits
July 1996	Dissertation	12 credits	12 credits
			64 credits

Program Formats

This 64-semester-hour program contains six semesters, with each semester lasting six months. It is designed so that it can be completed in three years without interrupting the student's professional career. This program combines a carefully balanced mixture of traditional and nontraditional instruction. The student chooses one of two formats: *cluster* or *institute*. Each format includes group meetings and computer-based activities.

Students choosing the *cluster format* attend four cluster meetings per year. Cluster meetings are held quarterly over an extended weekend (Friday, Saturday, and half-day Sunday), at Nova University in Fort Lauderdale, Florida. Students choosing the *institute format* attend institutes twice a year at Nova University in Fort Lauderdale, Florida. Institutes are week-long meetings, usually held in January and July.

Cluster and institute meetings bring together students, faculty, staff, and nationally recognized lecturers for participation in lectures, workshops, training, discussions and dissertation counseling. Courses are taught during these meetings by a renowned faculty and distinguished professionals.

In the months between meetings, students study the course material, complete assignments, read the literature, prepare project proposals, complete research papers and applied research projects, and participate in a range of computer-based activities that facilitate frequent interaction with faculty, classmates, and colleagues.

Computer-based activities include Nova's real-time Electronic Classroom sessions, online real-time computer discussions and conferences, electronic submission of completed assignments for review by faculty, electronic-mail communications, Nova's electronic library, and online academic advisement sessions. The Internet is also used extensively in support of student research and computer-mediated communication with experts and fellow students throughout the world.

Costs for clusters, institutes and computer-based activities are included as part of the student's tuition. Lodging and travel expenses related to clusters and institutes, however, are the responsibility of the student.

ADMISSIONS AND GENERAL INFORMATION FOR DOCTORAL PROGRAMS

Admission Requirements

Applicants for a doctoral degree program must meet the following general requirements as well as the specific program requirements delineated in later sections. (At the option of Nova University, students may be admitted on a provisional basis pending completion of prerequisites.)

(1) The applicant must have a master's degree from a regionally accredited institution that fulfills requirements for doctoral work in the selected program.. (See specific requirements delineated below for your program.)
(2) Official transcripts of all prior graduate and undergraduate work must be sent directly from the institution to:

Center for Computer and Information Sciences
Nova University
3301 College Avenue
Fort Lauderdale, FL 33314

(3) Have a graduate GPA of at least 3.25.
(4) Submit a completed application with application fee.
(5) Provide three letters of recommendation.
(6) Submit a G.R.E. score or portfolio with appropriate work experience and credentials.
(7) Meet the specific program requirements described in the paragraphs below.

Specific Requirements for Computer Information Systems
This program is designed for students with a graduate degree in computer information systems, computer science, or a related area. The applicant should satisfy graduate prerequisites or have equivalent experience in information systems, programming languages, database systems, systems analysis and design, data communications and networks, computer architecture, and statistics.

Specific Requirements for Computer Science
This program is designed for students with a graduate degree in computer science, or a related area. The applicant should satisfy graduate prerequisites or have equivalent experience in programming languages, data communications and computer networks, operating systems, compilers, database management systems, theory of computation, design and analysis of algorithms, and computer architecture.

Specific Requirements for Computing Technology in Education
This program is designed for students with a graduate degree in education or a related area and experience with computer applications. The applicant should have completed a master's level course or have equivalent experience in applied statistics. (Not required for the specialization in Computer Education.)

Specific Requirements for Information Systems and Information Science
This program is designed for students with a graduate degree in information systems, information science, computer science, or a related area. The applicant should have completed a master's level course or have equivalent experience in applied statistics.

Application Submission

It is recommended that applications be submitted three months prior to the intended start date. Students submitting applications later than this are advised to contact the CCIS program office by telephone as soon as possible to make arrangements. Copies of transcripts are acceptable for unofficial early review. Students applying late may be granted provisional acceptance pending completion of the application process.

Degree Options and the Dissertation/MARP

The doctoral degrees granted in CCIS programs include:

- Doctor of Philosophy (Ph.D.)
- Doctor of Science (Sc.D.)
- Doctor of Education (Ed.D.)

Either the Ph.D. or Sc.D. degree may be earned in computer information systems, computer science, and information systems and science. Either the Ed.D., Ph.D. or Sc.D. degree may be earned in computing technology in education.

The Dissertation
The dissertation is the capstone activity for students who select either the Ph.D. or the Sc.D. degree option. It is the main focus of the final year of study and is the most important requirement for the Ph.D. or Sc.D. degree.

Each student is expected, with the help and approval of an advisor, to select an appropriate topic of sufficient scope to satisfy the requirements for the dissertation. The work should be original and should represent a significant extrapolation from a base of solid experience or knowledge in the area of specialization.

Dissertation results must, in a significant way, advance knowledge, improve professional practice and/or contribute to understanding in the field of study. Dissertation results must be of sufficient strength to distill from the work a paper worthy of publication in a journal or conference proceedings in the area or to use the work as the basis for a textbook or monograph. Although such publication is not a requirement for completing the doctoral degree, students are strongly encouraged to submit their dissertation research work for publication. Students often devote six months to the dissertation proposal and another six months for the dissertation report.

Dissertation reports are placed in the Nova University Library.

The MajorApplied Research Project (MARP)

The MARP is the capstone activity for students who select the Ed.D. degree option in the Computing Technology in Education Program. It is the main focus of the final year of study and is the most important requirement for the Ed.D. degree. The MARP is a practitioner's activity, where a real-world problem of significance is addressed in explicit detail. Many MARP's are project-oriented, although the classical research paradigm would also serve as a MARP-type project. The work should be original and should represent a significant extrapolation from a base of solid experience or knowledge in the area of specialization.

MARP results should be of sufficient strength to distill from the work a paper worthy of publication in a journal or conference proceedings in the area. Although such publication is not a requirement for completing the doctoral degree, students are strongly encouraged to submit their work for publication. Students often devote six months to the MARP proposal and another six months for the MARP report. (MARP reports are placed in the Nova University Library.) Students who favor the practitioner side of their profession tend to select the MARP, and students interested in the foundational aspects tend to select the dissertation.

The choice between dissertation and MARP is determined by the nature of the capstone activity: theoretical/foundational (dissertation) or practical (MARP). The decision between MARP and dissertation may be made at any time in the program.

Students following the dissertation path may select the Ph.D. or Sc.D. degree option at any time during the program. The difference between the Ph.D. and Sc.D. degree options is a name difference only. The practice of allowing this option is found at other universities that award both degrees and is by no means unique to Nova University.

Doctoral Programs Tuition and Fees

Tuition	$6,300/year (during scheduled portion of program)
Application Fee	$40 non-refundable
Registration Fee	$30 non-refundable
Late Registration Surcharge	$50 non-refundable
Graduation Fee	$50
Continuing Dissertation Services	$1000 per term

Note: Tuition and fees are subject to change. Textbooks are not included and must be purchased by the student. Students are responsible for their own lodging and travel expenses. Students must be registered to gain access to Nova's computing services. Students not registered but needing faculty/computing services, for other than dissertation, register for one (1) credit of continuing services per term.

Tuition Payment Policy

Tuition is due in full at registration time. Tuition and fees may be satisfied with payment by cash, check, money order, credit card, or financial aid as authorized on an individual's official financial award letter. If their company allows direct billing, the student must attach a letter from his/her employer to the registration form that formally requests that billing be made directly to the student's employer.

Tuition Reimbursement by Employers (Deferred Payment)

Proof of eligibility must be provided at registration time. A student choosing this option will pay 50 percent of the total tuition, plus all fees, at the time of registration, with the remaining 50 percent due five weeks after the course ends. A deferment fee of $50 must be paid at registration time.

Installment Plan

When registering, students may elect an installment payment plan. This plan requires three payments spread over 90 days. The first payment of 50 percent of the total tuition, plus all fees, is due at registration time, 25 percent is due 60 days after registration, and the remaining 25 percent is due 90 days after registration. The charge for this option, $50, is due at registration time. Postdated checks and credit card authorizations for installment must be submitted at registration time.

Change of Plans

If a student temporarily withdraws for a term this will naturally extend the length of the program. Students who miss an institute or cluster must make up courses at a future institute or cluster. Students attending a Florida cluster site may have to attend a different cluster site to pick up the missed course. Special permission is required and the student will need to complete a student action request in order to take courses at other cluster locations. Students in the computer-based/institute fomat who miss institute courses must make up these courses at future institutes.

Time Limitation

Students in a doctoral degree program are expected to complete requirements for the degree within seven years from the date of their first registration.

GENERAL INFORMATION REGARDING ALL GRADUATE PROGRAMS

Equipment and Computing Resources

CCIS graduate students are given computer accounts and are encouraged to use Nova's computing resources. There is a wealth of information and tools available to the online community and these features greatly enhance the study and research potential of the student. Students may gain access to these resources from computers located in laboratories on the campus, and may also gain access from locations distant to the campus, e.g., their homes. For remote access, either an IBM-compatible PC or an Apple/Macintosh computer is required as well as a modem. A 2400 baud modem is recommended, however a 1200 baud modem is sufficient. Students selecting the institute/computer-based format must have remote access in order to participate in computer-based activities.

Students in the local Fort Lauderdale area are encouraged to access the host computer by direct dial to 452-3300. Students away from the local Fort Lauderdale area can avoid a long-distance telephone charge by using the Tymnet data communication network. Over 85% of all CCIS students have access to Tymnet as a local phone call. (Call Tymnet at 1-800-336-0149 to determine the local Tymnet number.) Connection to Nova's host computer via Tymnet is restricted to non-business hours: nights, weekends, and declared holidays.

A few students may not have local Tymnet access. These students will have to find an alternate means of connecting to Nova's host computer, including: long-distance direct dial to Nova's host computer in Fort Lauderdale, Florida; out-of-state long distance connection to a Tymnet node; or access through the Internet. Many students are finding it effective to investigate local and commercial Internet opportunities, so that access to Nova's host computer is possible 24 hours a day. Students who wish to explore local opportunities for free or low-cost Internet access are encouraged to subscribe to two online Usenet newsgroups: **alt.internet.access.wanted** and **alt.internet.services**. For detailed information about subscribing to these newsgroups students should consult the online manual by typing "man rn" when logging in to Nova's host computer.

There are no direct limits to online time for students in the CCIS. We encourage students to use their online time wisely, to conserve resources, but we do not regularly place prescribed limits on online time. Online time that has been excessive and/or used for purposes other than those directly related to academics can result in a charge to the student of $15 US per hour. Students are notified before a charge for excessive hours is considered.

The Center's graduate programs utilize the campus-based fiber-optic network to gain access to various computing resources. Library and other media resources are available to students through the use of the electronic library and HYTELNET. The UNIX operating system provides a common base for research activities on microcomputers, minicomputers, and superminicomputers. Students have access to various university computing resources, which include AT&T 3B2, Gould Power Node, DEC RISC-based systems, a Harris Nighthawk, DEC minicomputers, PC and Macintosh laboratories. Nova is a member of SURAnet and maintains a T-1 link to the Internet.

Off-Campus Library Services

Off-Campus Library Services (OCLS) is a department of Nova University Libraries that provides off-campus students with library services available on campus. Students may order books, request articles, search catalogs, search indexes, and even talk directly with a reference librarian. OCLS may be accessed in many different ways. Materials may be ordered by mail, FAX, or toll-free telephone. A voice mail answering machine is available 24 hours a day to take requests when the office is closed. You can also obtain many different services by accessing the Electronic Library through the campus UNIX system. Using a home computer and modem, type "el" at the UNIX % prompt. This will give you full use of all of the OCLS services. There is no charge for most of these services. When books are borrowed, the student will have to pay a small charge for third-class (library rate) return postage to return the books. Most requests are filled on the first business day after they are received. All requests are sent out by first-class mail. Books are loaned to the student for one month. Periodical copies need not be returned. To contact OCLS by phone, call toll free (800) 541-6682.

Information Retrieval Services

The IRS conducts computer searches and is available to all students. The IRS has computer access to ERIC and more than 350 other databases, such as Books in Print. This is a valuable resource for assignments, projects, practicums, dissertations and is offered free of charge to all enrolled students. Students may contact the IRS online to request a literature search. The usercode is **irs**. For the online format that the IRS requires for a search, look in the eicbl menu online under the category **Information Retrieval Service.**

International Students

International Student Advising Service (305) 370-5695 or (800) 541-6682

An international student applying to Nova University must (l) obtain a student (F) visa or an exchange visitor (J-l) visa (students are not permitted to study in the United States on a visitor (B-2) visa); (2) submit all secondary school and/or college-level transcripts (transcripts must be an official English language translation); (3) demonstrate the ability to meet all costs of his or her education without financial aid from Nova University; (4) purchase medical insurance (J-l visas only); contact the international student advisor for further information concerning insurance; and (5) demonstrate proficiency in the English language with a minimum score of 550 on the Test of English as a Foreign Language (TOEFL) exam.

Veterans' Services and Benefits

Nova University's academic programs are approved for the training of veterans and other eligible persons by the Bureau of State Approval for Veterans' Training, Florida Department of Veterans' Affairs. Eligible veterans and veterans' dependents should contact the Office of the University Registrar, 3301 College Avenue, Fort Lauderdale, Florida, 33314, or telephone (305) 370-5685 or (800) 541-6682.

Financial Aid Information

Nova University offers several programs of student financial aid in order to assist the greatest number of its students possible in meeting educational expenses. In order to qualify and remain eligible for financial aid, students must be accepted for admission in a University program; be eligible for continued enrollment; be a U.S. citizen or in the United States for other than a temporary purpose; and be making satisfactory academic progress toward a stated educational objective in accordance with the University's policy on satisfactory progress for financial aid recipients. For information, call (305) 475-7411 or (800) 541-6682.

Travel Information

Nova University has its own full-service travel agency in the Rosenthal Student Center that can make reservations and issue airline tickets and rental cars. In addition, travel agents can also help make arrangements for trips and vacations. Nova's travel service accepts money orders and major credit cards. The travel staff can be reached at (305) 475-7522 or toll free (800) 541-6682.

College Bookstore

All required textbooks for course work can be obtained through Nova Books, Inc. (usercode: novabook) located on the main campus. The phone number is (305) 476-4750, or toll free (800) 541-6682.

Student ID Cards

Registered students are issued student I.D. card. These are required to check out books from the Einstein Library. Further, a number of businesses in the community will give students discounted rates on a variety of services ranging from movies to dinner if an I.D. card is shown. If an I.D. card is lost or destroyed, a new one may be requested at the registrar's office. There is an additional fee to replace a lost card.

Student Organizations

The Center encourages participation in professional organizations. CCIS students have the opportunity to become involved in several student chapters, including:

Association of Computing Machinery (ACM)
Institute of Electrical and Electronics Engineers (IEEE)
IEEE Computer Society

Each student organization has a faculty or staff member serving as an advisor and supporter. All students are encouraged to become involved as members of the various organizations or by running for office in these organizations. For additional information, call (800) 541-6682 or (305) 475-7352.

Alumni Association - International

Nova University has an active alumni association that is a division of the Office of University Relations and Development. The association is organized on three levels--local, state, and national--that work in concert to provide special programs and other services that promote the professional and intellectual growth of graduates and that maintain communications between graduates and the University. The Office of University Relations and Development also offers a credentials file service. Additional information can be obtained form the Office of University Relations and Development: (800) 541-6682 or (305) 475-7319.

Housing

Located on the main campus is the Davie Living Complex. One- and two-bedroom furnished and unfurnished apartments are available to graduate and married students without children. Utilities, basic cable TV, and central air conditioning are included in the housing rates. Interested students are invited to obtain further information from:

Office of Residential Life
Nova University
3301 College Avenue
Fort Lauderdale, Florida 33314
(305) 475-7052 or toll-free (800) 541-6682

ACADEMIC INFORMATION

Graduation Requirements

All degree-seeking students must complete the minimum credits as designated for the chosen major, plus meet the following requirements:

1. Admission as a degree-seeking candidate in one of the programs.
2. Completion of courses, master's thesis where appropriate and, for the doctorate, an approved dissertation or MARP as specified in program documentation.
3. Attendance at all required cluster or institute meetings.
4. Attainment of a cumulative grade point average of at least 3.0.
5. Payment of all tuition and fees.
6. Completion of a graduation form at the time of registration for the final term of course work.
7. Fulfillment of all obligations to the library, the student's program, and the comptroller's office.

Commencement

A commencement ceremony is held once a year in early summer (usually in June) for all Nova University graduate students who have completed graduation requirements within the academic year. In order to participate, students must file a graduation application. There is an additional fee for cap and gown rental. Contact the Office of the University Registrar at (305) 475-7400 or (800) 541-6682 for additional information.

Grading Policy

This policy applies to students entering a program starting after January 1, 1994. Faculty will assign course and project grades according to the following system:

Grade	Quality Points
A	4.0
A-	3.7
B+	3.2
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
F	0

Grades I and W, covered below, may be assigned to any registration. In addition, grades of Pass (P) and No Pass (NP) may be assigned to a dissertation registration. Grades of I, W, P, and NP do not affect the GPA.

Incomplete ("I")

A grade of Incomplete ("I") indicates that the student has not completed course requirements and the instructor has given the student additional time to do so. An "I" grade is not routinely assigned in courses, but only when there are mitigating circumstances to prevent completion of the course requirements. This grade may be assigned at the discretion of the instructor at the request of the student. Should the instructor choose to assign an "I," a contract must be completed and signed by both the instructor and the student with the original kept on record in the Program Office. This contract must contain an agreed completion date. If the work is not completed by that date, the "I" grade will be changed to "F".

Withdrawal ("W")

A grade of Withdrawal ("W") may be assigned when the student officially requests a withdrawal (in writing) from the course or project no later than one month prior to the end of the term. (Regarding refunds, see the paragraph below on Withdrawal Policy.)

Academic Standing

The grading policy requires students to maintain a cumulative grade point average of at least 3.0 for the duration of their chosen program. Failure to meet this requirement will result either in academic probation or dismissal as detailed below.

Probation and Dismissal Policy

A student with a grade point average greater than 2.5 but less than 3.0 for the first four completed courses and/or projects in their program will be placed on academic probation. Such students are counseled as to the number of courses they may take in order to facilitate raising of their averages. No more than four additional courses may be taken without achieving an overall grade point average of at least 3.0. Failure to achieve this grade point average at that time will result in dismissal from the program.

A student whose grade point average for the first four completed courses and/or projects is 2.5 or lower will be dismissed from the program. A student who receives two failing grades will be dismissed from the program. Students dismissed from the program may petition for readmission after one academic year. The records of such students will be examined by the Dean of the Center for Computer and Information Sciences and the Admissions Committee. If approval for readmission is granted, only those courses with grades of "B" or better will be applicable to the student's program.

Withdrawal Policy

Students who wish to withdraw from the program, either temporarily or permanently, or to withdraw from a course, must inform the Program Office in writing to be eligible for allowable refunds. Students who withdraw from the program and are later readmitted are subject to prevailing tuition rates.

Students who have registered for an upcoming term and notify the program office of their intention to withdraw from the program or from a course may be entitled to a refund of all or part of tuition paid (but not including fees). Students who wish to receive a refund of tuition upon withdrawal must submit a written request through U.S. mail to the CCIS program office. The following schedule will apply:

100 percent refund:	written request must be received prior to start of term
80 percent refund:	written request must be received within two weeks after term starts
60 percent refund:	written request must be received within three weeks after term starts
40 percent refund:	written request must be received within four weeks after term starts
20 percent refund:	written request must be received within five weeks after term starts

Student Records

The University maintains a system of record keeping and provides students with official grade reports and transcripts reflecting their academic progress. This system, maintained by the University Registrar, documents all official information from the time of application for

admission to graduation. Official hard copies of records are maintained by the Registrar's office. Records are secured via the computerized Student Information System (SIS) in addition to back-up hard copy files. Computer files are secure and kept up to date. The Registrar's office follows the American Association of Collegiate Registrar's and Admissions Officer's (AACRAO) guidelines for the retention and disposal of records. After the appropriate time period, hard copy files are retired to storage. Computer files are moved to historical files and permanent records are microfilmed for later reference.

Grievances

When questions about procedures, decisions, or judgments occur, counseling is available for discussion and resolution of differences. Students may also have recourse to more formal avenues of appeal and redress. An appeals policy is available upon request from the program director.

Special Students

Students may be permitted to take three to nine credits without enrolling for a degree program. Special student applicants are required to submit an application and $40 fee to the department. The applicant should indicate "special student" on the application form. Applications will be reviewed prior to registration, and students will be advised as to eligibility to take the requested courses. A "special student" is not eligible for a degree or financial aid.

APA Form and Style Requirements

The Center for Computer and Information Sciences has adopted the American Psychological Association's form and style manual for all written work. Students should adhere to the guidelines set forth in this publication for all assignments, examinations, projects, papers, and practicums. Careful attention to appropriate citations and referencing with regard to plagiarism are advised. Refer to the Nova University policy on original work with regard to plagiarism and its definition.

GRADUATE PROGRAM COURSE DESCRIPTIONS

M.S. in Computer Information Systems

MCIS 610 Data and File Structures
Data and file structure concepts, data record format and file organization, sequential vs. random file access methods, tree-based file structure and search techniques, indexing and data clustering, multiway sort/merge and sort algorithms, input/output blocking and buffering, and advanced secondary storage technology for multimedia binary large objects.

MCIS 620 Structure of Computer Information Systems
Covers major concepts and architecture of computer information systems, including information concepts; information flow; types of information systems; the role of information in planning operations, control, and decision making; integrated information systems across a range of functional elements. Computer information systems in organizations.

MCIS 621 Management of Information Systems Project and Resources
Life-cycle models/paradigms. Project planning and risk analysis. Project control including work breakdown structures, project scheduling, activities and milestones. Software cost estimations techniques/models. Software quality assurance and metrics for software productivity and quality. Inspections, walkthroughs, and reviews. Approaches to team organization. Configuration management. Automated project management tools. Software maintenance. Information system security. Procurement of software services and systems. Management of operational systems. Legal/ethical issues associated with CIS and software.

MCIS 622 Office Automation Systems
This course focuses on strategies for utilizing technology to handle the information used in the office to improve the quantity, content, and format of work performed. Topics include the design and implementation of an office automation system; strategies for successful end-user computing; OA applications including electronic mail and voice mail; windowing; multitasking; computer conferencing; computer supported cooperative work; project management software; and decision support programs. The impact of ISDN on the office environment will also be examined.

MCIS 623 Legal and Ethical Aspects of Computing
This course focuses on issues that involve computer impact and related societal concerns. Topics covered include transitional data flow; copyright protection; information as a source of economic power; rights to access to computer systems; computer crime; data privacy; establishing national priorities in the technical and social aspects of computing; current and anticipated uses of computer prediction; and protection of personal ethical concerns. National computer policies of Japan, France, Great Britain, and the European Economic Community and the status of regulation and emerging standards also will be examined.

MCIS 624 Computer Integrated Manufacturing
This course provides a framework for understanding how functional organization structure impacts the design of a management information system in a manufacturing setting. Special emphasis will be on marketing, manufacturing, and financial information systems. Topics covered include the product life cycle; production scheduling and capacity requirements planning; techniques for using MIS to make plant location and inventory management; layout decisions quality control; and internal accounting and funds management. Planning strategies for forecasting services, developing requirements and specifications, writing requests for proposals, and project management will be examined within the context of functional information systems.

MCIS 625 Computer Graphics for Information Managers
Presents computer graphics as an aid to information managers who need a clear means of presenting the analysis of information. Topics include basic graphic techniques (e.g. histograms, bar charts, pie charts), the theory of graphic presentation of information, desktop publishing software, presentation software, graphics monitors (EGA, CGA, VGA, RGB, composite), laser printers, computer screen projection systems, and standards.

MCIS 630 Database Systems
The methodologies and principles of database analysis and design are presented. Topics include conceptual modeling and specifications of databases, database design process and tools, functional analysis and methodologies for database design, entity-relationship model and advanced semantic modeling methods. The auxiliary concepts and theories of database systems will also be discussed in this course. These include the architectures of database systems, logical and physical database organizations, data models for database systems (network, hierarchical, relational and object-oriented model), relational algebra and calculus, query languages, normal forms, null values and partial information, relational database design utilizing dependencies, view design and integration, concurrency control, query optimization, client/server database applications, distributed databases, object-oriented databases, and the current research and development trends of database analysis, design, modeling, and applications. (Cross listing with CISC 6030).

MCIS 631 Database Management Systems Practicum
The techniques of database management systems will be applied to practical projects. Prerequisite: MCIS 630

MCIS 632 Distributed Database Management
Students will study information storage and retrieval in a distributed environment. Topics also include distributed processing networks; degrees of distribution; approaches to distribution--multiple unduplicated/duplicated and centralization/decentralization issues; management concerns and criteria; and technical developments in office systems (digital voice communications, LANS, electronic mail, decision support systems, etc.), and alternatives for distributed processing. Prerequisite: MCIS 630

MCIS 640 System Test and Evaluation
An analysis of the verification and validation process. Methods, techniques, procedure, and techniques for integration and acceptance testing. Reliability measurement. Goals for testing. Testing in the small and testing in the large. Allocation of testing resources. When to stop testing. Test case design methods. Black box software testing techniques including equivalence partitioning, boundary-value analysis, cause-effect graphing, and error guessing. White box software testing techniques including statement coverage criterion, edge coverage criterion, condition coverage criterion, and path coverage criterion. Test of concurrent and real-time systems.

MCIS 650 Computer Networks
Included are fundamental concepts of computer network architecture and topologies, introduction of open system interconnection model and standards, examination of transport protocol specifications and its applications, network application program interface (API), network management and other computer network applications.

MCIS 651 Telecommunications
Principles and applications of telecommunications software, hardware, networks, protocols, and related technologies. Telecommunications elements pertinent to the information cycle (generation, transmission, storage, retrieval), archiving, data security and system re-engineering, downsizing and outsourcing. Application of IEEE/ANSI 802.x, ISO/OSI, DoD, X.25, ISDN, and new common carrier services. Practical deployment of local, wide-area, and internetwork applications under domestic and international standards.

MCIS 652 Computer Security
This course provides a foundation for understanding computer and communications security issues and a framework for creating and implementing a viable security program. Topics covered will include hardware, software, and network security; the regulatory environment; personnel considerations; protective measures against a variety of potential threats including hackers, disgruntled insiders, and software viruses; and techniques for responding to incidents not prevented.

MCIS 654 Applications of the Internet
Enterprises thrive on information, and telecommunications is now viewed as an efficient means of disseminating and receiving information. The Internet has emerged as the dominant server for national and international data communications between commercial, government, military, and academic organizations and network hosts. This course will study the structure, organization, and use of the Internet. Internet tools and their potential application are examined including Telnet, anonymous FTP, Usenet News, Finger, Internet Relay Chat, Alex, Archie, Gopher, Hytelnet, Netfind, Prospero, Veronica, WAIS, WHOIS, and WWW. Students will be able to used the UNIX operating system and the Internet to successfully manage the efficient transfer of information to distant clients. (Cross listed with MMIS 654.)

MCIS 660 Information Systems Analysis
The requirements definition process including elicitation/fact-finding, problem analysis and decomposition, and the requirements document. User, customer, developer, and technology-related issues. The behavioral specification. Structuring and modeling techniques for requirements definition and behavioral specification. Structured analysis, object-oriented analysis, state machine techniques, decision tables and trees. Techniques for real-time and non-real-time systems. Specifying non-behavioral requirements. The role of prototyping. Comparison of analysis techniques.

MCIS 670 Artificial Intelligence and Expert Systems
This course will include an introduction to artificial intelligence as well as historical and current trends and characterization of knowledge-based systems. Search, logic and deduction, knowledge representation, production systems, and expert systems will be examined. Additional areas include architecture of expert systems and criteria for selecting expert system shells, such as end-user interface, developer interface, system interface, inference engine, knowledge base, and data interface. The student will use a commercial shell to build a working expert system.

MCIS 671 Decision Support Systems
This course will examine concepts of decision support in both a non-automated and automated environments. Emphasis will be placed on structures, modeling, and the application of various decision support systems in today's corporate environment. Additional emphasis will be placed on the use of executive information and expert system applications. Case studies will be used to look at existent applications of each of these types of technology.

MCIS 672 Computer-Aided Software Engineering
Computer-Aided Software Engineering (CASE) is a technique in which the path between initial systems analysis and the final coding of programs can be at least partly automated. Topics include a critical comparison between CASE and 4GLs (Fourth-Generation Languages), upper CASE (analysis/design), lower CASE (code generation and testing), tool kits, workbenches, methodology companions, platforms, completeness and consistency checking. Prerequisite: an undergraduate course in a structured programming language.

MCIS 680 Human-Computer Interaction
This course focuses on the dynamics of human-computer interaction (HCI). It provides a broad overview of HCI as a sub-area of the computer sciences and offers specific background relating to user-centered design approaches in information systems applications. Areas to be addressed include the user interface and software design strategies, user experience levels, interaction styles, usability engineering, and collaborative systems technology. Students will perform formal software evaluations and usability tests.

MCIS 682 Information Systems Project
Students are assigned a project that involves part or all of the system development cycle. Students will gain experience in analyzing, designing, implementing, and evaluating information systems applications. Prerequisite: consent of instructor.

MCIS 683 Data Center Management
This course stresses information center methods for building systems between users and analysts. The traditional life-cycle development will be reviewed. The role and services of the information center will be discussed within the context of these issues: user support, goals in terms of user education and training, promoting systems support and development services, and promulgating and monitoring use of standards for software and for protection of data resources. Other topics in this course include principles of application generators, prototyping, user and provider roles in an information center. Students will be able to identify strengths and limitations of the information center approach.

MCIS 690 System Design and Implementation
Design principles including abstraction, modularity, encapsulation, information hiding, and reusability will be addressed. Additional areas include quality factors, decomposition of complex systems, and modularization techniques. The relationship of design and implementation to the requirements definition and behavioral specification phases of the life-cycle will be examined. In-depth study of a variety of design methods including object-oriented design, function-oriented design, and data structure-oriented design. Interface specification, design tools and environments, programming languages, coding style, and efficiency will also be examined.

MCIS 691 Special Topics in Information Systems
This seminar will focus on the professor's current research interests. Prerequisite: prior consent of instructor and program director.

M.S. in Computer Science

CISC 610 Programming Languages
Formal languages and language hierarchies, syntactic and semantic specification, abstract machines and corresponding languages, context-free languages, abstraction, modularity, and program structure. Fundamental programming language concepts. Analysis of imperative, object-oriented, and declarative language paradigms. Several programming languages will be analyzed. (Formerly titled Theory and Principles of Programming).

CISC 612 Concurrent Programming Languages
An introduction to concurrent programming languages. Modules and class structures, packages and concurrent tasks in ADA. Processes, statements, and transaction calls in C. Generic procedures. Concurrent programming, mailbox tasks, signals and semaphores. Abstract data types, operations on abstract objectives, hiding of the representation of objectives of a given type, private data types.

CISC 615 Design and Analysis of Algorithms
Topics include sorting, algorithms for tree structures, dynamic programming, greedy methods, advanced data structures, divide and conquer, graph algorithms, arithmetic operations, algorithms for parallel computers, matrix operations, string/pattern matching, network problems, approximation algorithms, and NP-completeness.

CISC 620 Modeling and Simulation
Use of logical and mathematical models to represent and simulate events and processes as well as computer, information, and communications systems. Introduction to computer modeling techniques and discrete-event simulation. Model development and testing. Output and problem analysis. Application of techniques to a multiprocessor system model and an Ethernet model. Examination of development programs such as GPSS, SIMULA, and SIMSCRIPT.

CISC 622 Numerical Analysis
Introduction to error analysis, iterative methods, eigenvalue problems, integration and differentiation by computer, interpolation, ill-conditioned problems.

CISC 630 Compiler Design Theory
Language theory will be applied to the design of a compiler for a high-level language. Parsing, syntax analysis, semantic analysis, and code generation . Other areas of the compilation process will be covered, such as storage allocation, symbol table management, searching and sorting, and optimization.

CISC 631 Language Theory and Automata
Introduction to formal grammars, Backus-Naur notation. The formal theory behind the design of a computer language is studied. The corresponding types of automata which may serve as recognizers and generators for a language will be described.

CISC 632 Compiler Implementation
Design, implementation, and test of a compiler for a high-level language. The compiler project will utilize state-of-the-art compiler generation tools, including parser generators and code generator generators. Prerequisite: CISC 630.

CISC 634 Complexity Theory
A general theory of computation and complexity. Theory of algorithms, Turing machines, unsolvable problems, exponential difficulty, and NP-Completeness.

CISC 640 Operating Systems Theory and Design
Analysis of computer operating systems with emphasis on structured design. Multiprogramming and multiprocessing, real-time, time-sharing, networks, job control, scheduling, synchronization, and other forms of resource management: I/O programming memory and file system management.

CISC 643 Array Processors and Supercomputers
An introduction to supercomputers. Parallel computer organization. Pipeline, associative and array computer architectures. Examples: Texas Instruments ASC, Control Data STARAN, CRAY-I, Burroughs BSP. Control and parallel processors. Stream of microinstructions. Conflict-free memory, algorithmic detection of recurrent relations, and control flow graphs.

CISC 644 Operating Systems Implementation
Implementation and testing of operating system designs. Prereq: CISC 640.

CISC 645 Microprogramming and Microprocessors
The state of the art of microprogramming will be discussed in detail with particular attention to processor technology. An in-depth survey of commercially available microprogrammable microprocessors will be presented as well as monolithic microprogrammed devices. The students will implement a processor instruction set in both vertical and horizontal microcode utilizing a Simulator, Microassembler, and Register Transfer language.

CISC 646 Distributed Computing Systems
The course will introduce the concepts and design of distributed computing systems and the state-of-the-art of distributed computing application programming. Included are the basic concepts of distributed systems: transparency, heterogeneity, network process communication, distributed client-server and other distributed computer system models, network file systems (NFS), communication protocols (TCP/IP), synchronization, naming, and process and resource management. The state-of-the-art portion concentrates on developing distributed applications by both low-level and high-level remote procedure (RPC) programming, socket-based interprocess communication and implementation. Network programming projects will be on the UNIX-based platforms. Prerequisites: C Programming Language, Data Structures, Operating Systems and UNIX.

CISC 647 Advanced Computer Architecture
A study of the organizational structures of computer systems and subsystems. Topics include processor organization, memory organization, virtual memory, microarchitecture, I/O controllers and processors, architectures for complex instruction set computers (CISC) and reduced instruction set computers (RISC), performance evaluation, multiprocessors and parallel architectures.

CISC 650 Network Design and Analysis
Distributed processing and other forms of network systems. Various network protocols and implementation approaches will be presented. Network projects in concurrent languages will be required.

CISC 651 Data and Computer Communications
An introduction to data communications including interfacing, transmission, link control, and multiplexing. Networking techniques including circuit switching, packet switching, radio and satellite networks, and local area networks. The architecture of computer communications including communications protocols, the OSI model, the TCP/IP protocol suite, network access protocols (e.g. X.25, internetworking, session services and protocols, and presentation/application (higher-layer) protocols. An overview of the integrated services digital network (ISDN). (Formerly titled Data Communications).

CISC 660 Database Management Systems
The principles of database management systems are presented. Topics include concepts of database architectures such as three schema architectures, logical and physical data organizations, data models for database systems (network model, hierarchical model, relational model and object-oriented model), relational algebra and calculus, query languages, design theory for relational databases, functional dependencies and normal forms, null values and partial information, semantic data modeling, transaction management and concurrency control, index schema, file structures and access methods, query systems and query optimization, view management, client/server database architectures, distributed databases, object-oriented databases, logic-based databases, and the current research and development trends of database systems.

CISC 661 Database Management Systems Practicum
Techniques of database management will be applied to practical projects. Prereq.: CISC 660.

CISC 662 Distributed Database
The study of information storage and retrieval in a distributed environment and distributed processing networks.

CISC 663 Object-Oriented Database Systems
Object-oriented data models and other data models with semantic extensions such as functional data models, object-oriented database query model and languages, object-oriented database schema evolution and modification, version management and control, object data storage structure (clustering and indexing), query processing and transaction management, authorization mechanism and security, integrating object-oriented programming and databases, and applications of object-oriented databases (Prerequisite CISC 660).

CISC 670 Artificial Intelligence
Basic principles and techniques of artificial intelligence will be covered. Concepts of knowledge representation including formalized symbolic logic, inconsistency and uncertainty, probabilistic reasoning, and structured knowledge will be presented. Other areas include knowledge organization and manipulation including search and control strategies, matching techniques, and knowledge management, perception and communication including natural language processing and pattern recognition, and the architecture of expert systems.

CISC 671 Robotics and Automated Processing
Principles and concepts of modern robots and automation. Concepts of algorithmic and nonalgorithmic control plus the details of sensor and device I/O. Experiments with simulated and real robots will be performed to reinforce the basic concepts presented.

CISC 680 Software Engineering
The development of software-intensive systems; software quality factors; software quality factors; software engineering principles; system life-cycle models/paradigms; requirements definition and analysis; behavioral specification; software design; implementation; software testing techniques; verification and validation; system evolution; software project management.

CISC 681 Interactive Computer Graphics
The principles of interactive computer graphics are presented. Emphasis will be placed on mastering the concepts of two-dimensional graphics including the basic transformations (scale, translate, rotate), perspective, hidden-line removal, and hardware support devices. The two-dimensional concepts will be extended to include three-dimensional computer graphics including smoothing algorithms, animation, and a variety of related topics.

CISC 682 Software Engineering Implementation
Techniques of software engineering will be applied in projects. Prerequisite: CISC 680.

CISC 683 Object-Oriented Design
The concepts and principles of the object-oriented paradigm. Approaches to analyzing and modeling a system using object-oriented techniques. Techniques for the design of objects, classes, and modules. The use of inheritance to enhance reusability. Object-oriented analysis and object-oriented programming.

CISC 690 Special Topics
This seminar will focus on the professor's current research interests. Prerequisite: consent of instructor and program director.

M.S. in Computing Technology in Education

MCTE 610 Structured Programming in Pascal and Logo
This course is based on the premise that educators with expertise in computer education must have background knowledge in programming languages such as Pascal and Logo if they are to offer leadership in developing strategies on how creative uses of computing can be used in education. The concepts in this course focus on how students can use computing languages to enhance critical thinking.

MCTE 615 Online Information Systems
Internet and other online information systems associated with the evolving information super-highway will soon have a dominant role in how information is organized and retrieved. Consequently, educators must have fundamental knowledge of the many online information systems available if they hope to expose their students to the full range of available reference sources. The emphasis for this course will be placed on developing effective online skills so that bibliographic, full text, and numerical information can be gained in an efficient manner.

MCTE 620 Computer Literacy and Educational Reform
This course emphasizes that computer literacy will continue to become an essential skill in a society where information is a valued commodity. Educators are charged with the responsibility to prepare students for the information society. This course emphasizes technological equity among students; the role of technology in an information society; community support for computing across the curriculum; state and federal legislation related to funding for computing in education and educational reform; computer literacy and global challenges to productivity; and new models of teaching that emphasize problem-solving, higher-order thinking, and team interaction.

MCTE 625 Survey of Courseware
Students will explore various types of computer-based courseware. Macintosh and PC Computer-Assisted Instruction applications using hypertext, frame based and multimedia formats are evaluated for appropriateness for the intended learning audience. Characteristics of tutorials, drill and practice, instructional games, simulations and tests are surveyed.

MCTE 626 Authoring Systems Design
Functionality and characteristics of PC and Macintosh authoring systems, frame-based, multimedia, and hypertext are explored in this course. Instructional systems design methodology in conjunction with authoring tools is examined and critiqued.

MCTE 630 Database Systems
Included are fundamentals of database architecture, database management systems, and database systems. Principles and methodologies of database design, and techniques for database application development.

MCTE 640 Computing Technology Facilities Planning
Issues presented in this course include establishing computer laboratories and enhancing classroom facilities by incorporating computers. An investigation of computer laboratories designed for faculty use, training, and support. Topics presented include establishing the computer laboratory and selecting hardware; types of software; physical layout of the laboratory; printers; networking possibilities; considerations relating to the physical environment; and scheduling methods.

MCTE 650 Computer Networks
This course is focused on the following areas: fundamental concepts of computer network architecture and topologies, open system interconnection models and standards, analysis of transport protocol specification, network program interface, network management, and emerging computer network applications. An area that is covered in detail includes network standards that determine how data are transferred: Ethernet, token ring, and Fiber Distributed Data Interface. Attention will also be directed toward issues affecting operating peripherals, including CD-ROM drives and printers.

MCTE 660 Multimedia and Emerging Technologies
Recent advances and future trends in learning technology and future trends in educational computing are examined. Innovations in teacher and student workstation technology are reviewed. Emphasis is placed on an examination of audio/video and computer-based tools currently in use in schools and training centers. Special attention is given to CD-ROM technology and laser disk technology. Guidelines for selection of instruction technology and design and implementation of multimedia projects are presented.

MCTE 670 Learning Theory and Computer Applications
Students will explore learning theories and how learning is achieved when instruction is presented from a computer-based paradigm. The course will emphasize the computer as a learning device that can be used in effective manner to model learning theories associated with behaviorism, cognitivism, and human information processing.

MCTE 680 Human-Computer Interaction
This course explores the emerging field of human-computer interaction. Emphasis is placed on how software design practices are integrated with human factors principles and methods. Other issues presented in the course include: user experience levels; interaction styles; usability engineering; interaction devices and strategies; user-centered design; human information processing; social aspects of computing; and computer-supported cooperative work.

MCTE 690 Computer-Based Statistics
Introduction to statistical analysis and decision making. Study of data types, data contributions, the identification of variables and descriptive data presentation techniques. Parametric and non-parametric data analysis procedures including independent and dependent sample t-tests, chi-square analysis and simple analysis of variance. Emphasis on hypothesis testing and the use of statistical software packages.

MCTE 698 Directed Study in Training and Learning I
Readings, research, implementation, or other form of study as arranged with instructor.

MCTE 699 Directed Study in Training and Learning II
Readings, research, implementation, or other form of study as arranged with instructor.

M.S. in Management Information Systems

MMIS 610 Survey of Computer Languages
A study of high-level languages, fourth-generation languages, and command languages used in the development of software for management information systems. The logical and physical structure of programs and data. Concepts of structured programming. Data structures, file management, and their use in problem solving. Students will complete a variety of high-level language computer programs.

MMIS 615 Quantitative Methods
This course serves as an introduction to the basic quantitative tools needed to support problem solving and decision making in the information systems environment. Heavy emphasis is placed on the application of these tools in a case-based, real-world environment.

MMIS 620 Management Information Systems
The application of information system concepts to the collection, retention, and dissemination of information for management planning and decision making. Conceptual foundations, structure, planning and development of management information systems. The role of MIS in an organization and the fit between the system and the organization.

MMIS 621 Information Systems Project Management
Practical examination of how projects can be managed from start to finish. Life-cycle models/paradigms. Life-cycle phases. Project planning and risk analysis. Project control including work breakdown structures, project scheduling, activities and milestones. Software cost estimations techniques/models. Software quality assurance and metrics for software productivity and quality. Inspections, walkthroughs, and reviews. Approaches to team organization. Documentation and configuration management. Automated project management tools. Software maintenance. Procurement of software services and systems.

MMIS 622 Office Automation Systems
This course focuses on strategies for utilizing technology to handle the information used in the office to improve the quantity, content, and format of work performed. Topics include the design and implementation of an office automation system; strategies for successful end-user computing; OA applications including electronic mail and voice mail; windowing; multitasking; computer conferencing; computer supported cooperative work; project management software; and decision support programs. The impact of ISDN on the office environment will also be examined. (Cross listed with MCIS 622.)

MMIS 623 Legal and Ethical Aspects of Computing
This course focuses on issues that involve computer impact and related societal concerns. Topics covered include transitional data flow; copyright protection; information as a source of economic power; rights to access to computer systems; computer crime; data privacy; establishing national priorities in the technical and social aspects of computing; current and anticipated uses of computer prediction; and protection of personal ethical concerns. National computer policies of Japan, France, Great Britain, and the European Economic Community and the status of regulation and emerging standards also will be examined. (Cross listed with MCIS 623.)

MMIS 624 Computer Integrated Manufacturing
This course provides a framework for understanding how functional organization structure impacts the design of a management information system in a manufacturing setting. Special emphasis will be on marketing, manufacturing, and financial information systems. Topics covered include the product life cycle; production scheduling and capacity requirements planning; techniques for using MIS to make plant location and inventory management; layout decisions quality control; and internal accounting and funds management. Planning strategies for forecasting services, developing requirements and specifications, writing requests for proposals, and project management will be examined within the context of functional information systems. (Cross listed with MCIS 624.)

MMIS 625 Computer Graphics for Information Managers
Presents computer graphics as an aid to information managers who need a clear means of presenting the analysis of information. Topics include basic graphic techniques (e.g. histograms, bar charts, pie charts), the theory of graphic presentation of information, desktop publishing software, presentation software, graphics monitors (EGA, CGA, VGA, RGB, composite), laser printers, computer screen projection systems, and standards. (Cross listed with MCIS 625.)

MMIS 626 Application of Microcomputer Systems
Selection and use of microcomputers, including hardware and software, to support management information systems. Distributed microcomputer systems, e.g., the integrated office automation system. Electronic mail, computer conferencing, voice mail, project management software, imaging systems, and the sharing of databases, spreadsheets, word processing files, etc. Microcomputer networking techniques, security and backup. Multimedia systems.

MMIS 630 Databases in MIS
The application of database concepts to management information systems. Design objectives, methods, costs, and benefits associated with the use of a database management system. Tools and techniques for the management of large amounts of data. Database design, performance and administration. File organization and access methods. The architectures of database systems, data models for database systems (network, hierarchical, relational and object-oriented model), client/server database applications, distributed databases, and object-oriented databases.

MMIS 631 Databases in MIS Practicum
The techniques of database management systems will be applied to practical projects. Prerequisite: MMIS 630 (Cross listed with MCIS 631.)

MMIS 632 Distributed Database Systems
Students will study information storage and retrieval in a distributed environment. Topics include distributed processing networks; degrees of distribution; approaches to distribution--multiple unduplicated/duplicated and centralization/decentralization issues; management concerns and criteria; and technical developments in office systems (digital voice communications, LANS, electronic mail, decision support systems, etc.), and alternatives for distributed processing. Prerequisite: MMIS 630 (Cross listed with MCIS 632.)

MMIS 640 System Test and Evaluation
An analysis of the verification and validation process. Methods, techniques, procedure, and techniques for integration and acceptance testing. Reliability measurement. Goals for testing. Testing in the small and testing in the large. Allocation of testing resources. When to stop testing. Test case design methods. Black box software testing techniques including equivalence partitioning, boundary-value analysis, cause-effect graphing, and error guessing. White box software testing techniques including statement coverage criterion, edge coverage criterion, condition coverage criterion, and path coverage criterion. Test of concurrent and real-time systems. (Cross listed with MCIS 640.)

MMIS 641 Organization of the Computing Environment
This course focuses on management topics related to the modern information systems environment. Issues such as personnel selection, budgeting, policy development, organizational interfacing, and hardware and software selection are discussed. Special attention is given to the role of tactical and strategic planning using information systems technology.

MMIS 652 Computer Security
This course provides a foundation for understanding computer and communications security issues and a framework for creating and implementing a viable security program. Topics covered will include hardware, software, and network security; the regulatory environment; personnel considerations; protective measures against a variety of potential threats including hackers, disgruntled insiders, and software viruses; and techniques for responding to incidents not prevented. (Cross listing with MCIS 652.)

MMIS 653 Telecommunications and Computer Networking
The role of telecommunications and computer networks in management information systems. Technical fundamentals and design of telecommunications and computer networks. Strategies, tools, and techniques for network planning, implementation, management, maintenance, and security. Topics include ISDN and B-ISDN, the OSI Model, transmission media, network operating systems, topologies, configurations, protocols, and performance characteristics. Trends in standardization, internetworking, downsizing, and the development of local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), and enterprise-wide networks are examined.

MMIS 654 Applications of the Internet
Enterprises thrive on information, and telecommunications is now viewed as an efficient means of disseminating and receiving information. The Internet has emerged as the dominant server for national and international data communications between commercial, government, military, and academic organizations and network hosts. This course will study the structure, organization, and use of the Internet. Internet tools and their potential application are examined including Telnet, anonymous FTP, Usenet News, Finger, Internet Relay Chat, Alex, Archie, Gopher, Hytelnet, Netfind, Prospero, Veronica, WAIS, WHOIS, and WWW. Students will be able to used the UNIX operating system and the Internet to successfully manage the efficient transfer of information to distant clients. (Cross listed with MCIS 654.)

MMIS 660 Systems Analysis
The process of analyzing requirements for management information systems. Elicitation/fact-finding, problem analysis and decomposition, and the requirements document. Concepts, methods, techniques, and tools for systems analysis, modeling and simulation, and prototyping. Structured and object-oriented analysis. Feasibility studies and cost/benefit analyses. Role of the systems analyst in the organization. Gaining user commitment and fulfilling user needs.

MMIS 670 Artificial Intelligence and Expert Systems
This course will include an introduction to artificial intelligence as well as historical and current trends and characterization of knowledge-based systems. Search, logic and deduction, knowledge representation, production systems, and expert systems will be examined. Additional areas include architecture of expert systems and criteria for selecting expert system shells, such as end-user interface, developer interface, system interface, inference engine, knowledge base, and data interface. The student will use a commercial shell to build a working expert system. (Cross listed with MCIS 670.)

MMIS 671 Decision Support Systems
This course will examine concepts of decision support in both non-automated and automated environments. Emphasis will be placed on structures, modeling, and the application of various decision support systems in today's corporate environment. Additional emphasis will be placed on the use of executive information and expert system applications. Case studies will be used to look at existent applications of each of these types of technology. (Cross listed with MCIS 671.)

MMIS 672 Computer-Aided Software Engineering
Computer-Aided Software Engineering (CASE) is a technique in which the path between initial systems analysis and the final coding of programs can be at least partly automated. Topics include a critical comparison between CASE and 4GLs (Fourth-Generation Languages), upper CASE (analysis/design), lower CASE (code generation and testing), tool kits, workbenches, methodology companions, platforms, completeness and consistency checking. Prerequisite: an undergraduate course in a structured programming language. (Cross listed with MCIS 672.)

MMIS 680 Human-Computer Interaction
This course focuses on the dynamics of human-computer interaction (HCI). It provides a broad overview and offers specific background relating to user-centered design approaches in information systems applications. Areas to be addressed include the user interface and software design strategies, user experience levels, interaction styles, usability engineering, and collaborative systems technology. Students will perform formal software evaluations and usability tests. (Cross listing with MCIS 680.)

MMIS 683 Data Center Management
This course stresses information center methods for building systems between users and analysts. The traditional life-cycle development will be reviewed. The role and services of the information center will be discussed within the context of these issues: user support, goals in terms of user education and training, promoting systems support and development services, and promulgating and monitoring use of standards for software and for protection of data resources. Other topics in this course include principles of application generators, prototyping, user and provider roles in an information center. Students will be able to identify strengths and limitations of the information center approach. (Cross listing with MCIS 683.)

MMIS 690 Systems Design
Concepts, tools, and techniques for systems design. Design principles, quality factors, decomposition of complex systems, and modularization techniques. The relationship of design and implementation to the requirements definition and specification phases of the life-cycle. Design methods such as object-oriented design and function-oriented design. Documentation, implementation, system testing and evaluation, and systems interfacing considerations. Equipment selection. Design of on-line systems and distributed systems. System performance, response time, and reliability.

Ph.D. or Sc.D. in Computer Information Systems

DCIS 710 Decision Support Systems (3 credits)
Principles and techniques relating to decision making, systems modeling, and support. Topics include decision theory, simulation, decision support system architecture, constructing a decision support system, executive information systems, and expert systems to support decision making in information systems.

DCIS 720 Human-Computer Interaction (3 credits)
Techniques facilitating effective human-computer interaction are presented. Basic elements, procedures, tools, and environments contributing to the development of a successful user interface are explored. Design principles, guidelines, and methodologies for building, installing, managing, and maintaining interactive systems that optimize user productivity are reviewed. Topics include the multidisciplinary dynamics of human computer interaction, current and projected developments in HCI research, computer supported cooperative work, and strategies for implementing and evaluation human-computer dialogues.

DCIS 730 Structure of Computer Information Systems (3 credits)
Covers major concepts and architecture of computer information systems including information concepts; information flow; types of information systems; the role of information in planning, operations, control, and decision making; and integrated information systems across a range of functional elements.

DCIS 740 Data Communications and Computer Networking (3 credits)
Data transmission encoding, interfacing, synchronization, data-link control, multiplexing, networking, circuit switching, packet switching, radio and satellite networks, local area networks, network access protocols, transport/session/presentation/application protocols, TCP/IP, OSI, and ISDN.

DCIS 750 Database Management Systems (3 credits)
Theory and principles of databases and their management. Design, implementation, and traditional and nontraditional applications of database management systems.

DCIS 760 Artificial Intelligence and Expert Systems (3 credits)
Covers the theory of and major approaches to artificial intelligence, including knowledge representation, heuristics, search, learning techniques, tools and techniques for applying artificial intelligence, and knowledge-based expert systems.

DCIS 770 Software Engineering (3 credits)
The development of software-intensive systems, quality factors and principles related to software engineering, system life-cycles, requirements definition and analysis, behavioral specification, design, implementation, verification and validation, system evolution, and project management.

DCIS 780 Information Systems Analysis (3 credits)
An in-depth study of techniques, methods, and tools for the analysis and specification of information systems. Topics include: the requirements definition process including fact-finding, problem/needs analysis and decomposition, and the requirements document; system life-cycle models; application development strategies; feasibility assessment; logical specification of the planned system; the behavioral specification; the role of prototyping; structuring and modeling techniques for requirements definition and behavioral specification including object-oriented techniques; the relationship between analysis and verification and validation; and techniques for management of the analysis process.

DCIS 810 Project in Decision Support Systems (4 credits)
Students advance their knowledge through the completion of a research paper or project in the area of decision support systems. Some topics of current interest include comparisons of decision support aids, the relationship between decision support systems and expert systems, DSS hardware and software, group DSS, distributed DSS and data communications, and human problem solving through DSS.

DCIS 820 Project in Human-Computer Interaction (4 credits)
Students compile a research paper or project that examines, in depth, a current topic in HCI, such as HCI modeling, interface quality and evaluation, computer system and interface architecture, social aspects of computing, legal and ethical aspects of computing, and computer-supported cooperative work (CSCW).

DCIS 830 Project on the Structure of Computer Information Systems (4 credits)
Students pursue a research project, implementation, or simulation study on a current topic in computer information systems. Some topics of current interest are distributed information systems, information systems management, security, enterprise models, evolution models, technology transition, real-time systems, manufacturing systems, and system simulation.

DCIS 840 Project in Data Communications and Computer Networking (4 credits)
Students pursue a research project, implementation, or simulation study on a current topic in data communications and/or computer networking. Some topics of current interest are client/server computing, internetworking, network management, ONC, DCE, DME, TCP/IP, OSI, and ISDN.

DCIS 850 Project in Database Management Systems (4 credits)
Students pursue a research study on a current topic in database systems or complete a database-oriented development project. Some areas of current interest include object-oriented database systems, extended relational DBMS, deductive and logic-based expert systems, federated or heterogeneous database systems, other high-performance parallel database systems, and advanced conceptual logic database modeling.

DCIS 860 Project in Artificial Intelligence and Expert Systems (4 credits)
Students pursue a research project or implementation on a current topic in artificial intelligence. Some topics of current interest are natural language processing, understanding, parallel and distributed AI, expert systems, and connectionist models such as neural networks.

DCIS 870 Project in Software Engineering (4 credits)
Students pursue a research study in a current topic in software engineering or complete a software engineering development project. Some topics of current interest include object-oriented analysis and design, software/system life cycles, reusability, specification, and verification.

DCIS 880 Project in Information Systems Analysis (4 credits)
Students pursue a research study or implementation on a current topic in information systems analysis. Some topics of current interest include object-oriented analysis techniques and methods, specification methods, information modeling, validation and verification requirements, and the role of prototyping.

Ph.D. or Sc.D. in Computer Science

CISD 700 Theory and Principles of Programming (3 credits)
Concepts of imperative, object-oriented, functional, logic, and concurrent programming. Structures of modern languages, language semantics and static types. Concepts are illustrated using examples from contemporary languages.

CISD 710 Modeling and Simulation (3 credits)
An in-depth treatment of modeling and simulation techniques and mathematical programming. Major topics include discrete event simulation, model building, validation, output data analysis, simulation languages, linear and nonlinear programming, integer programming, and mathematical optimization.

CISD 720 Compilers, Language Theory, and Automata (3 credits)
Advanced topics in compiler design and language theory. Compiler development tools and their construction, compiler testing and validation techniques, and advances in language definition and representation.

CISD 730 Operating Systems (3 credits)
An in-depth treatment of major areas of operating systems theory, design, and implementation. Process concepts, asynchronous concurrent processes, concurrent programming, deadlock, indefinite postponement, real storage, virtual storage organization, virtual storage management, job and processor scheduling, distributed computing, auxiliary storage management, performance, and security.

CISD 740 Data Communications and Computer Networking (3 credits)
Data transmission encoding, interfacing, synchronization, data-link control, multiplexing, networking, circuit switching, packet switching, radio and satellite networks, local area networks, network access protocols, transport/session/presentation/application protocols, TCP/IP, OSI, and ISDN.

CISD 750 Database Management Systems (3 credits)
Theory and principles of databases and their management. Design, implementation, and traditional and nontraditional applications of database management systems.

CISD 760 Artificial Intelligence (3 credits)
Covers the theory of and major approaches to artificial intelligence, including knowledge representation, heuristics, search, learning techniques, tools and techniques for applying artificial intelligence, and knowledge-based expert systems.

CISD 770 Software Engineering (3 credits)
The development of software-intensive systems, quality factors and principles related to software engineering, system life-cycles, requirements definition and analysis, behavioral specification, design, implementation, verification and validation, system evolution, and project management.

CISD 800 Theory and Principles of Programming Project (4 credits)
The mathematics of algorithm and program construction are the basis for this project, which illustrates the benefits of applying structured programming, using program documentation, and using program assertion to produce correct programs. Current projects include the use of a modern language to demonstrate the benefits of its structures on program development.

CISD 810 Modeling and Simulation Project (4 credits)
The mathematics of model representation and systems analysis are at the center of this project. From the design of a model to its analysis, each phase of a simulation model is analyzed. Current projects use the techniques of discrete event simulation, mathematical programming, statistical precision, and systems analysis to study the performance of an industrial system.

CISD 820 Project in Compilers, Language Theory, and Automata (4 credits)
Current projects attempt to focus on the implementation of new languages in an effort to broaden the technical horizons of the implementer. Projects employ the latest software development techniques, as well as utilization of various compiler development tools.

CISD 830 Project in Operating Systems (4 credits)
The student may elect to do an implementation or write a research paper. Implementation projects may involve constructing a portion of an operating system, simulating the behavior of key components of an operating system, actual performance studies of existing systems, creation of a concurrent programming environment to model parallel hardware and software, or the like. Research papers may investigate current topics of interest, such as UNIX, MACH, OS/2, Windows/NT, open systems, multiprocessing, distributed computing, massive parallelism, object-oriented operating systems, real-time operating systems, etc.

CISD 840 Project in Data Communications and Computer Networking (4 credits)
Students pursue a research project, implementation, or simulation study on a current topic in data communications and/or computer networking. Some topics of current interest are client/server computing, internetworking, network management, ONC, DCE, DME, TCP/IP, OSI, and ISDN.

CISD 850 Project in Database Management Systems (4 credits)
Students pursue a research study on a current topic in database systems or complete a database-oriented development project. Some areas of current interest include object-oriented database systems, extended relational DBMS, deductive and logic-based expert database systems, federated or heterogeneous database systems, other high-performance parallel database systems, and advanced conceptual logic database modeling.

CISD 860 Project in Artificial Intelligence (4 credits)
Students pursue a research project or implementation on a current topic in artificial intelligence. Some topics of current interest are natural language processing, understanding, parallel and distributed AI, expert systems, and connectionist models such as neural networks.

CISD 870 Project in Software Engineering (4 credits)
Students pursue a research study in a current topic in software engineering or complete a software engineering development project. Some topics of current interest include object-oriented analysis and design, software/system life cycles, reusability, specification, and verification.

Ph.D., Ed.D., or Sc.D. in Computing Technology in Education

DCTE 710 Computer-Based Research and Statistics (3 credits)
An in-depth treatment of the research and evaluation process including design, measurement, and statistical analysis is provided. Techniques for planning, designing, and conducting research and evaluation projects and collecting and analyzing data using various statistical techniques are examined. Special emphasis is placed on the selection of appropriate methodologies for a variety of problem-solving situations. Software programs for performing statistical procedures are reviewed.

DCTE 715 Management of Computing Resources (3 credits)
New developments in information technology management are examined. Practical techniques and methods for managing hardware, software, communications, distributed. Guidelines for creating an environment that integrates next generation computing components for maximum information accessibility are introduced. Various approaches to project planning, managing change and innovation, and facilitating computer and communications security are reviewed.

DCTE 720 Human-Computer Interaction (3 credits)
Techniques facilitating effective human-computer interaction are presented. Basic elements, procedures, tools, and environments contributing to the development of a successful user interface are explored. Design principles, guidelines, and methodologies for building, installing, managing, and maintaining interactive systems that optimize user productivity are reviewed. Topics include the multidisciplinary dynamics of human computer interaction, current and projected developments in HCI research, computer supported cooperative work, and strategies for implementing and evaluating human-computer dialogues.

DCTE 735 Application of Authoring Systems to Curriculum Design (3 credits)
American education has become increasingly dependent on computer-mediated instruction. To meet this need for good software that matches instructional tasks to instructional media, many educational practitioners are turning to authoring systems. This course will stress the capabilities of authoring systems, both hypertext and frame-based paradigms. Students in this course will explore the use of authoring systems as tools for the curricular design of tutorials, drill and practice activities, instructional games, and simulations.

DCTE 740 Telecommunications and Computer Networks (3 credits)
Recent advances and new applications in the expanding field of telecommunications and computer networks are examined. The technical fundamentals, architecture, and design of computer networks are described. Strategies, tools, and techniques for network planning, implementation, management, maintenance, and security are delineated. Topics include ISDN and B-ISDN, the OSI Model, transmission media, network operating systems, topologies, configurations, protocols, and performance characteristics. Trends in standardization, internetworking, downsizing, and the development of local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), and enterprise-wide networks are examined.

DCTE 745 Multimedia and Emerging Technologies (3 credits)
Recent advances in high performance computing and computer networks and their impact on network-bases applications and workgroup productivity are examined. New developments in optical storage technologies, imaging systems, computer architectures, communications services, and graphical user interfaces are delineated. Trends in the development and use of multimedia to support instruction, learning, and research are described. Tools, techniques, and guidelines facilitating the planning, design, production, and implementation of multimedia projects are delineated.

DCTE 747 Computer Application of Learning Theory (3 credits)
Computing machinery and other forms of high technology are assuming an increasingly dominant role in instructional delivery and school management. Many states are investing considerable resources on studies related to technology and student learning. This course will examine the complexity of learning and behavioral change, with emphasis placed on how computing machinery can be used effectively in the learning process.

DCTE 750 Applied Database Management Systems (3 credits)
Techniques for determining database requirements and managing organizational data resources are examined. Strategies for designing database management systems applications that satisfy specific requirements are presented. Components and architecture of the relational data model are analyzed. Methods for creating and implementing object-oriented information systems are explored. Topics include object-oriented languages, the user interface, databases and expert systems, distributed computing, and the advantages and drawbacks of commercially available DBMS tools and products.

DCTE 755 Courseware and Educational Programming Languages (3 credits)
This course is an indepth exploration of the basic concepts, principles and methods of software design, including methodologies, the software product life cycle, levels of design, design presentations, design documentation, and design practices and techniques found in instructional software. The student will develop competencies in analyzing and synthesizing design for courseware using on-line tools such as C-Pilot and Writers Workbench, off-line tools such as Hypercard, ToolBook, and Linkway Live, and other tools such as authoring systems, and structured programming and educational languages.

DCTE 760 Artificial Intelligence and Expert Systems (3 credits)
Principles underlying basic AI research and their applications in practice are introduced. Key AI concepts including knowledge representation, natural language processing, machine learning, and heuristic search techniques are examined. Special emphasis is place on examining the characteristics, attributes, conceptual design and structure of expert systems. An in-depth analysis is presented of the tools, techniques, methods, and processes involved in building, implementing, and maintaining expert systems that comply with specific needs and requirements.

DCTE 765 Systems Analysis for Educational Computing Systems (3 credits)
An in-depth study of techniques, methods, and tools for the analysis and specification of requirements for educational computing systems. Topics include: the requirements definition process including fact-finding, problem/needs analysis and decomposition, and the requirements document; system life-cycle models; application development strategies; feasibility assessment; logical specification of the planned system; the behavioral specification; the role of prototyping; structuring and modeling techniques for requirements definition and behavioral specification including object-oriented techniques; an overview of design, implementation, and verification and validation; and techniques for project management.

DCTE 790 Computer Networks (3 credits)
The technical fundamentals, design, configuration, and implementation of computer networks are described. Networking applications that are revolutionizing information access and delivery are examined. Strategies, tools, and techniques to expedite network planning, management, maintenance, and security are reviewed. Topics include information communications, the OSI Model, ISDN and B-ISDN, transmission media, network architecture, operating systems, topologies, protocols, and performance characteristics. Trends in standardization, internetworking, downsizing, and the development of local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), and enterprise-wide networks are delineated.

DCTE 795 Telecommunications (3 credits)
An introduction to key aspects of the telecommunications from fundamental communications concepts and principles to new directions in information transfer and delivery is presented. methods, tools, and techniques for telecommunication planning, forecasting services, developing requirements and specifications, and project management are described. Strategies for integrating communication elements into computer networks are delineated. Topics include communications media, services, architectures, protocols, and standards. New applications in voice, video, data, and image communications are discussed. Recent developments in data communications and distributed networks, satellite communications, fiber optics, and client/server computing are examined.

DCTE 810 Project in Computer-Based Research and Statistics (4 credits)
DCTE 815 Project in Management of Computing Resources (4 credits)
DCTE 820 Project in Human-Computer Interaction (4 credits)
DCTE 835 Project in Application of Authoring Systems to Curriculum Design (4 cr.)
DCTE 840 Project in Telecommunications and Networking (4 credits)
DCTE 845 Project in Multimedia and Emerging Technologies (4 credits)
DCTE 847 Project in Computer Application of Learning Theory (4 credits)
DCTE 850 Project in Applied Database Management Systems (4 credits)
DCTE 860 Project in Artificial Intelligence and Expert Systems (4 credits)
DCTE 865 Project in Systems Analysis for Educational Computing Systems (4 cr.)
DCTE 870 Project in Courseware and Educational Programming Languages (4 cr.)
DCTE 890 Project in Computer Networks (4 credits)
DCTE 895 Project in Telecommunications (4 credits)

Ph.D. or Sc.D. in Information Systems

DISS 710 Decision Support Systems (3 credits)
An introduction to the concepts, structure, functions, capabilities, and limitations of decision support systems (DSS) is presented. Development tools and techniques for constructing DSS are surveyed. Case studies illustrating managerial applications of DSS are reviewed. Guidelines for DSS implementation are explored.

DISS 715 Management of Computing Resources (3 credits)
New developments in information technology management are examined. Practical techniques and methods for managing hardware, software, communications, distributed applications, multimedia systems, and end user computing are described. Guidelines for creating and environment that integrates next generation computing components for maximum information accessibility are introduced. Various approaches to project planning, managing change and innovation, and facilitating computer and communications security are reviewed.

DISS 720 Human-Computer Interaction (3 credits)
Techniques facilitating effective human-computer interaction are presented. Basic elements, procedures, tools, and environments contributing to the development of a successful user interface are explored. Design principles, guidelines, and methodologies for building, installing, managing, and maintaining interactive systems that optimize user productivity are reviewed. Topics include the multidisciplinary dynamics of human computer interaction, current and projected developments in HCI research, computer supported cooperative work, and strategies for implementing and evaluating human computer dialogues.

DISS 730 Information Systems Structure (3 credits)
Major concepts and architecture of computer information systems, including information concepts; information flow; types of information systems; the role of information in planning operations, control, and decision making; integrated information systems across a range of functional elements, real-time systems, and computer information systems in organizations. Tools and methods expediting the design of information systems to meet specific needs and application requirements are examined. Strategies for information systems planning, implementation, and management are reviewed. Trends in the development of group support systems, expert systems, and office automation systems are described. Techniques for creating a comprehensive enterprise-wide plan to optimize productivity through the use of enterprise architecture planning are delineated.

DISS 740 Telecommunications and Computer Networks (3 credits)
Recent advances and new applications in the expanding field of telecommunications and computer networks are examined. The technical fundamentals, architecture, and design of computer networks are described. Strategies, tools, and techniques for network planning, implementation, management, maintenance, and security are delineated. Topics include ISDN and B-ISDN, the OSI Model, transmission media, network operating systems, topologies, configurations, protocols, and performance characteristics. Trends in standardization, internetworking, downsizing, and the development of local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), and enterprise-wide networks are examined.

DISS 750 Applied Database Management Systems (3 credits)
Techniques for determining database requirements and managing organizational data resources are examined. Strategies for designing database management systems applications that satisfy specific requirements are presented. Components and architecture of the relational data model are analyzed. Methods for creating and implementing object-oriented information systems are explored. Topics include object-oriented languages, the user interface, databases and expert systems, distributed computing, and the advantages and drawbacks of commercially available DBMS tools, and products.

DISS 760 System Design, Test, and Evaluation (3 credits)
Design principles including abstraction, modularity, encapsulation, information hiding, and reusability. Quality factors, decomposition of complex systems, and modularization techniques. The relationship of design to requirements definition and behavioral specification. In-depth study of a variety of design methods including object-oriented design and function-oriented design. Analysis of the verification and validation process. Methods, techniques, procedure, and techniques for integration and acceptance testing. Reliability measurement. Goals for testing. Testing in the small and testing in the large. Allocation of testing resources. When to stop testing. Test case design methods. Black box software testing techniques including equivalence partitioning, boundary-value analysis, cause-effect graphing, and error guessing. White box software testing techniques including statement coverage criterion, edge coverage criterion, condition coverage criterion, and path coverage criterion. Test of concurrent and real-time systems.

DISS 780 Information Systems Analysis (3 credits)
An in-depth study of techniques, methods, and tools for the analysis and specification of information systems. Topics include: the requirements definition process including fact-finding, problem/needs analysis and decomposition, and the requirements document; system life-cycle models; application development strategies; feasibility assessment; logical specification of the planned system; the behavioral specification; the role of prototyping; structuring and modeling techniques for requirements definition and behavioral specification including object-oriented techniques; the relationship between analysis and verification and validation; and techniques for management of the analysis process.

DISS 810 Project in Decision Support Systems (4 credits)
DISS 815 Project in Management of Computing Resources (4 credits)
DISS 820 Project in Human-Computer Interaction (4 credits)
DISS 830 Project in Information Systems Structure (4 credits)
DISS 840 Project in Telecommunications and Computer Networks (4 credits)
DISS 850 Project in Applied Database Management Systems (4 credits)
DISS 860 Project in System Design, Test, and Evaluation (4 credits)
DISS 880 Project in Information Systems Analysis (4 credits)

Ph.D. or Sc.D. in Information Science

DISS 715 Management of Computer Resources (3 credits)
New developments in information technology management are examined. Practical techniques and methods for managing hardware, software, communications, distributed applications, multimedia systems, and end user computing are described. Guidelines for creating an environment that integrate next generation computing components for maximum information accessibility are introduced. Various approaches to project planning, managing change and innovation, and facilitating computer and communications security are reviewed.

DISS 720 Human-Computer Interaction (3 credits)
Techniques facilitating effective human-computer interaction are presented. Basic elements, procedures, tools, and environments contributing to the development of a successful user interface are explored. Design principles, guidelines, and methodologies for building, installing, managing, and maintaining interactive systems that optimize user productivity are reviewed. Topics include the multidisciplinary dynamics of human computer interaction, current and projected developments in HCI research, computer supported cooperative work, and strategies for implementing and evaluation human-computer dialogues.

DISS 725 Structure of Library Information Systems (3 credits)
The evolution, design, and structure of online information systems are examined. Principles, concepts, and techniques for online information retrieval are described. Topics include the methodology of the search process, bibliometrics, the Internet, the user interface, hypertext and hypermedia, CD-ROM and related technologies, and standardization. Case studies highlighting the planning, implementation, and management of online information systems are discussed. Trends in system enhancements, the use of remote online services for information retrieval, electronic document delivery, electronic publishing, and end-user training are reviewed. Problems and issues associated with electronic information access and delivery are noted.

DISS 735 Technology-Based Cataloging (3 credits)
Current issues and approaches in online catalog design and functionality are examined. Technical capacities, services, products, and programs offered by major bibliographic utilities such as OCLC and RLIN to facilitate shared cataloging, enhance subject access, increase interlibrary loan efficiency and document delivery, and optimize bibliographic control are described. New opportunities provided by LC-MARC records for collection management are noted. Costs and technical complexities involved in retrospective conversion of bibliographic records are delineated. The implications of adding local databases, community information, full text, and images to the catalog and linking online catalogs with other online systems are described. Topics include the user interface, staff training, outsourcing support, and criteria for vendor selection.

DISS 745 Multimedia and Emerging Technologies (3 credits)
Recent advances in high performance computing and computer networks and their impact on network-based applications and work-group productivity are examined. New developments in optical storage technologies, imaging systems, computer architectures, communications services, and graphical user interfaces are delineated. Trends in the development and the use of multimedia to support instruction, learning, and research are described. Tools, techniques, and guidelines facilitating the planning, design, production, and implementation of multimedia products are delineated.

DISS 750 Applied Database Management Systems (3 credits)
Techniques for determining database requirements and managing organizational data resources are examined. Strategies for designing database management systems applications that satisfy specific requirements are presented. Components and architecture of the relational data model are analyzed. Methods for creating and implementing object-oriented information systems are explored. Topics include object-oriented languages, the user interface, databases and expert systems, distributed computing, and the advantages and drawbacks of commercially available DBMS tools and products.

DISS 790 Computer Networks (3 credits)
The technical fundamentals, design, configuration, and implementation of computer networks are described. Networking applications that are revolutionizing information access and delivery are examined. Strategies, tools, and techniques to expedite network planning, management, maintenance, and security are reviewed. Topics include information communications, the OSI Model, ISDN, and B-ISDN, transmission media, network architecture, operating systems, topologies, protocols, and performance characteristics. Trends in standardization, internetworking, downsizing, and the development of local area networks (LANs), wide area networks (WANs), metropolitan area networks (MANs), and enterprise-wide networks are delineated.

DISS 795 Telecommunications (3 credits)
An introduction to key aspects of telecommunications from fundamental communications concepts and principles to new directions in information transfer and delivery is presented. Methods, tools, and techniques for telecommunications planning, forecasting services, developing requirements and specifications, and project management are described. Strategies for integrating communications elements into computer networks are delineated. Topics include communications media, services, architectures, protocols, and standards. New applications in voice, video, data, and image communications are discussed. Recent developments in data communications and distributed networks, satellite communications, fiber optics, and client/server computing are examined.

DISS 815 Project in Management of Computer Resources (4 credits)

DISS 820 Project in Human-Computer Interaction (4 credits)

DISS 825 Project in Structure of Library Information Systems (4 credits)

DISS 835 Project in Technology-Based Cataloging (4 credits)

DISS 845 Project in Multimedia and Emerging Technologies (4 credits)

DISS 850 Project in Applied Database Management Systems (4 credits)

DISS 890 Project in Computer Networks (4 credits)

DISS 895 Project in Telecommunications (4 credits)

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