

## MATHEMATICS AND COMPUTER SCIENCE

Chair: Steven D. Bourquin

**Faculty:** Donald E. Beken, William H. Campbell, Gwenyth Campen, Melissa R. Edwards\*, Linda Falls, Joseph W. Goldston, Linda Hafer, Susan B. Hanby, Gangadhar R. Hiremath, Mary Klinikowski\*\*, Raymond Lee, Cindy Li, Charles Lillie, Douglas McBroom, Leszek Piatkiewicz, Scott Turner, Guo Wei, Leonard J. Wilkins, Cynthia Zhang, Laszlo Zsilinszky

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Mathematics has been central to human achievement for over three thousand years, important to both intellectual advancement and technological innovation. Many of the theoretical studies in mathematics have evolved and have been refined over a long period of time. Many of the practical aspects of mathematics have become more evident with the advent of calculators and computers. Computer technology is assuming a major role in society. Clearly, the computer revolution is the beginning of a new age of human existence. Many of the problems computer scientists and others will be expected to solve in decades to come have yet to be considered. As such, computing has evolved into a science covering the study of languages, programming, and theoretical concepts. The Department offers courses covering the intellectual and the practical sides of mathematics and computing.

A student of the Department of Mathematics and Computer Science has the opportunity of earning a Bachelor of Science degree (B.S.) in Mathematics, Computer Science, or Information Technology or a Master's degree in Mathematics Education. The Mathematics major also may choose to gain licensure to teach mathematics at the secondary or middle grades level. The Department offers minors in mathematics, computer science, and information technology.

The Departmental faculty welcomes the opportunity to advise the major and non-major alike. Someone thinking of majoring in mathematics, computer science, or information technology is especially urged to consult with the Department Chair prior to registering for General Education courses. All majors choose advisors and must consult with them each term in order to plan and carry out their program of study.

The Department web pages at [www.uncp.edu/mathcs/](http://www.uncp.edu/mathcs/) contain current information about the activities, the faculty, and the offerings of the department. Department majors are expected to consult the website regularly to remain informed.

Most non-majors fulfill the General Education requirements in mathematics by taking one of MAT 1050, 1070, or 1080. Well-prepared students may select MAT 1090 or 2210 for this purpose.

### BACHELOR OF SCIENCE IN MATHEMATICS

<b>Requirements for a Bachelor of Science Degree in Mathematics: Major in Mathematics</b>	<b>Sem. Hrs.</b>
Freshman Seminar	1
General Education Requirements	44
Prospective Mathematics Majors should start with MAT 1090 as their General Education course in mathematics. MAT 1070 & MAT 1080 or MAT 2210 may be used in place of MAT 1090	
Major Requirements	42
MAT 2210, 2220, 2300, 2600, 3150, 3250, 3310, 3600, 4310, 4600, and 12 additional sem. hrs. of advanced mathematics (PHY 3360 may count for 3 hours)	
Electives	33
	<b>Total: 120</b>

**BACHELOR OF SCIENCE IN MATHEMATICS EDUCATION  
SECONDARY MATHEMATICS EDUCATION 9-12 CONCENTRATION and  
MIDDLE GRADES MATHEMATICS EDUCATION 6-9 CONCENTRATION**

Coordinator: Melissa R. Edwards

Upon successful completion of the program of study in Mathematics Education and related requirements, graduates are eligible for a Standard Professional I license to teach in the State of North Carolina. For a more detailed description, including the program standards and goals and objectives, turn to Undergraduate Licensure Programs in the School of Education section of this catalog.

<b>Course Requirements—Secondary Concentration (9-12)</b>	<b>Sem. Hrs.</b>
<b>Freshman Seminar and General Education</b>	<b>45</b>
<b>Content Courses</b>	<b>42</b>
MAT 2210, 2220, 2300, 2600, 3110, 3150, 3250, 3310, 3280, 3330, 3600, 4110, 4310, 4020, 4600	
<b>Professional Studies Core</b>	<b>12</b>
EDN 2100, 3130, 3140, SED 3310	
<b>Content Pedagogy</b>	<b>25</b>
MAT 2500, 3500, 3750, 4000, 4490, 4750 CSC 4050	
<b>General Electives</b>	<b>3</b>
	<b>Total: 127</b>

<b>Course Requirements—Middle Grades Concentration (6-9)</b>	<b>Sem. Hrs.</b>
<b>Freshman Seminar and General Education</b>	<b>45</b>
<b>Content Courses</b>	<b>27</b>
MAT 1070*, 1080*, 2100*, 2110, 2150*, 2300, 2600, 3150, 3600, 4020	
<b>Second Academic Concentration</b> (Several courses will also count towards General Education requirements.)	<b>18-30</b>
<b>Professional Studies Core</b>	<b>15</b>
EDN 2100, 3130, 3140, 3400; SED 3310	
<b>Content Pedagogy</b>	<b>25</b>
MAT 2500, 3500, 3750, 4000, 4490, 4750 CSC 4050	
<b>General Electives</b> (Depending on second concentration requirements)	<b>0-4</b>
	<b>Total: 128</b>

\* Six hours of these specialty area courses will count towards General Education requirements.

NOTE: Students who desire teacher licensure in Mathematics Education should declare the major as soon as possible in their college career. Consultation with the Program Coordinator or program advisor prior to registering for General Education courses is strongly recommended.

**BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

<b>Requirements for a Bachelor of Science Degree in Computer Science</b>	<b>Sem. Hrs.</b>
Freshman Seminar	1
General Education Requirements*	44

Note: Prospective Computer Science Majors should start with MAT 1090 as their first General Education mathematics course. MAT 1070 and MAT 1080 or MAT 2210 may be used in place of MAT 1090

Major Requirements	51
CSC 1750, 1760, 1850, 2150, 2250, 2260, 2650, 2850, 2920, 3750, 4900; MAT 2210, 2220, 3150, 3280, 4020	
Four courses from the following list (at least one must be a 4000-level course): CSC 3350, 3380, 3650, 3800, 3910, 3920, 3930, 4010, 4020, 4150, 4350, 4360, 4450, 4810, 4820, 4970; MAT 3270	12
Note: Students planning to attend graduate school in computer science should take CSC 4010, 4150, 4350, and 4450.	
Other electives	12

**Total: 120**

\*Computer Science majors must take PHY 1500 or PHY 2000 and one course from Biology, Chemistry, or HON 1500 to satisfy the six hours of Natural Science requirements in General Education.

### BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

Requirements for a Bachelor of Science Degree in Information Technology	Sem. Hrs.
<b>Freshman Seminar</b>	1
General Education Requirements	44
Note: Prospective Information Technology Majors should start with MAT 1090 or MAT 1070 as their first General Education mathematics course.	
Major Core Requirements	53
CSC 1300, 1750, 1760, 1850, 1900, 2050, 2150, 2250, 2260, 2850, 2920	
ITC 2060, 2080, 4940	
MAT 2100, 2150, 4020	
Major Elective Requirements	12
Four courses from the following list (at least one must be a 4000-level course): ITC 2700, 3100, 3250, 4100, 4200, 4800, 4960; CSC 3380, 3800, 4020	
Other Electives	10
<b>Total:</b>	<b>120</b>

### ACADEMIC CONCENTRATION

Requirements for an Academic Concentration in Mathematics	Sem. Hrs.
MAT 1050, 1070, 1080, 2100, 2110, 2150, 4020, CSC 4050	
<b>Total:</b>	<b>25</b>

### MINORS

Requirements for a Minor in Mathematics	Sem. Hrs.
MAT 2210, 2220, 3150, 3310, and three additional hours selected from advanced mathematics courses (3000 or above)	18
<b>Requirements for a Minor in Computer Science with Emphasis in Programming</b>	<b>Sem. Hrs.</b>
CSC 1750, 1760, 1850, 2150, 2250; one course from CSC 1300, 2260, 2650, 2850, or 2920	18

<b>Requirements for a Minor in Computer Science with Emphasis in World Wide Web</b>	<b>Sem. Hrs.</b>
CSC 1300, 1750, 1760, 1900, 2260, 3380	18

<b>Requirements for a Minor in Information Technology</b>	<b>Sem. Hrs.</b>
CSC 1750, 1760; ITC 2060, 2080; one course from CSC 1300 or ITC 2700; and one advanced ITC course (3000 or above)	18

## COURSES

### MATHEMATICS (MAT)

#### **MAT 0104. Fundamentals of Mathematics (3 credits)**

A study of topics in algebra that are essential for success in college algebra (MAT 107). Content includes solving of linear equations and inequalities as well as systems of linear equations and inequalities. Topics from geometry, polynomials, factoring, rational expressions, and radicals are also studied. (This course does not count toward earned hours or graduation requirements. Most students will be placed in this course by scores on the Mathematics Placement Test.)

#### **MAT 1050. Introduction to College Mathematics (3 credits)**

Topics from mathematics which may include sets, logic, algebra, graphs, functions, systems of linear equations and inequalities, geometry, probability, and statistics. Problem solving is emphasized. **This course is intended to be a general education course and NOT a preparation for college algebra.** Some sections of the course will develop a theme for the applications of mathematical concepts. (Credit for MAT 1050 will not be allowed if the student has previously received a grade of C or better in a math course with a higher catalog number, unless the course is being taken to replace a grade or to fulfill a requirement.)

#### **MAT 1070. College Algebra (3 credits)**

A study of the real and complex number systems, algebraic expressions and equations, polynomial and rational functions and their graphs, inequalities and their graphs, exponential and logarithmic functions and their graphs, systems of equations, and conic sections. **This course is intended to be a preparation for calculus** (MAT 2150 and MAT 2210). A very good understanding of high school algebra is required.

#### **MAT 1080. Plane Trigonometry (3 credits)**

A study of angle measures, trigonometric functions and their values, inverse trigonometric functions and their values, graphs of trigonometric and inverse trigonometric functions, solutions of right and oblique triangles, trigonometric identities and equations, polar coordinates, vectors, and rotation of axes. **This course is intended to be a preparation for calculus** (MAT 2210). PREREQ: MAT 1070.

#### **MAT 1090. Precalculus (4 credits)**

This course is an accelerated version of MAT 1070 and MAT 1080 combined. See both course descriptions for a list of topics covered. This course is intended as a **rapid review** of the topics in preparation for calculus.

#### **MAT 1180. Finite Mathematics (3 credits)**

Set theory, symbolic logic, permutations and combinations, probability, conditional probability, matrices and systems of equations. Some applications to stochastic processes, Markov chains, linear programming, statistics. PREREQ: MAT 1070 or equivalent.

#### **MAT 2100. Introduction to Statistics (3 credits)**

Elementary statistics, descriptive and inferential. Graphing data sets, finding measures of center, position, and dispersion. Probability, linear regression and correlation. Central Limit Theorem, sampling and hypothesis testing, including z-tests, student's tests, F-test, Chi-Square, and ANOVA. The use of calculators and computers is an integral part of the course. Recommended PREREQ: MAT 1070 or equivalent.

**MAT 2110. Survey of Geometry (3 credits)**

Topics covered involve: Plane and Solid Geometry, Coordinate Geometry, Transformational Geometry, Trigonometry, Logic, and Measurement Systems. These topics will emphasize fundamental concepts: points, lines, planes, angles, polygons, circle, perimeter, area, surface area, volume, and construction of figures. Various types of technology will be incorporated throughout the course. PREREQ: MAT 1070 and 1080 or equivalent.

**MAT 2150. Calculus with Applications (4 credits)**

Required for Biology majors. Not open to Mathematics majors. A study of functions of one variable; derivatives, integrals and their applications to Biological Sciences and Business. Special attention will be given to exponential functions with respect to growth and decay applications. Topics of multi-variable calculus will also be included. PREREQ: MAT 1070 or MAT 1090 or equivalent.

**MAT 2210. Calculus I (4 credits)**

Study of functions of one variable, topics from analytic geometry, limits and continuity; differentiation of algebraic functions; curve sketching; various applications chosen from physics, economics, and optimization. PREREQ: MAT 1070 and MAT 1080, or MAT 1090, or equivalent.

**MAT 2220. Calculus II (4 credits)**

A study of integrals, the definite integral, the fundamental theorem of the calculus, applications of the definite integral. The derivative and integral of exponential, logarithmic, trigonometric and inverse trigonometric functions; and techniques of integration. PREREQ: C or better in MAT 2210.

**MAT 2300. Introduction to Advanced Mathematics (3 credits)**

Introduction to set theory, elementary concepts of the topology of the real line and the plane, elementary logic, and techniques of proof. PREREQ: MAT 2210 or 2150.

**MAT 2500. Introduction to Teaching Mathematics in Middle Grades and Secondary Schools (2 credits)**

Designed to provide an overview of mathematics in the secondary school and early experiences for prospective mathematics teachers. These experiences include a planned program of observational and participatory experience in the mathematics classroom. PREREQ: EDN 3020, MAT 2210 or 2150.

**MAT 2600. Connections in Mathematics I (1 credit)**

This seminar course is designed to help mathematics and mathematics education majors connect and deepen their mathematical understandings of calculus-related topics. Emphasis will be placed on research and communication of mathematical ideas. Major course work will include production of portfolio artifacts that represent the major's development of understanding in the mathematics curriculum. PREREQ/COREQ: MAT 2220.

**MAT 3110. Advanced Euclidean Geometry (3 credits)**

Topics include Plane and Solid Geometry, Coordinate Geometry, Transformational Geometry, Trigonometry, Logic, and the Systemization of Euclidean Theorems and Postulates. These topics will emphasize fundamental concepts: points, lines, planes, angles, congruence, similarity, concurrence, polygons, circle, perimeter, area, surface area, volume, and construction of figures. Various types of technology will be incorporated throughout the course. PREREQ: MAT 1070 and 1080 or equivalent and MAT 2300.

**MAT 3150. Linear Algebra I (3 credits)**

An introduction to the theory of vector spaces, linear transformations, systems of linear equations, matrices, inverses, rank, determinants, inner products. Applications of matrices to problems involving systems of equations. PREREQ: MAT 2210 or 2150.

**MAT 3170. Linear Algebra II (3 credits)**

Eigenvalues and eigenvectors, similarity of matrices, reduction of matrices to diagonal form. Cayley-Hamilton theorem, minimum polynomial, Jordan canonical form. Hermitian, unitary, and normal matrices, orthonormal basis, Gram-Schmidt process. Simplification of quadratic forms and other applications. PREREQ: MAT 3150.

**MAT 3250. Algebra I (3 credits)**

Introduction to groups, integral domains, rings and fields, with further study of subgroups, cyclic groups, groups of permutations, isomorphisms and homomorphisms of groups, direct products, and factor groups. PREREQ: MAT 2300; PREREQ or COREQ: MAT 3150.

**MAT 3260. Algebra II (3 credits)**

Further topics in group theory; rings, integral domains, fields, ideals, quotient rings, homomorphisms, direct sums, polynomial rings, extension fields. PREREQ: MAT 3250.

**MAT 3270. Numerical Analysis (3 credits)**

An introduction to the solution of mathematical problems by computational techniques, including both finite and iterative methods and error analysis. PREREQ: MAT 3150, 3310, and one high-level programming language.

**MAT 3280. Probability and Statistics I (3 credits)**

Probability, sample spaces, counting techniques, random variables, discrete and continuous distribution functions, characteristics functions. Binomial, Poisson, and normal distributions. Central limit theorems. PREREQ: MAT 2220.

**MAT 3300. Probability and Statistics II (3 credits)**

Introduction to common theoretical distributions, central limit theorems, two dimensional random variables, sampling distributions, confidence intervals, hypothesis testing, regression theory and applications. PREREQ: MAT 3310, 3280.

**MAT 3310. Calculus III (4 credits)**

A continuation of Calculus I and II from an advanced viewpoint. L'Hospital's rule, improper integrals, Taylor's theorem, infinite series. Multi-variable calculus: limits, continuity, partial derivatives, extrema, iterated integrals, and applications. PREREQ: C or better in MAT 2220.

**MAT 3320. Differential Equations (3 credits)**

An introduction to ordinary differential equations including classification of solutions to differential equations, existence and uniqueness of solutions, power series methods, initial value problems, and applications. PREREQ: MAT 3310.

**MAT 3330. Discrete Mathematics (3 credits)**

Provides an introduction to discrete mathematics. Topics include graph theory, proof techniques, elementary combinatorics, discrete probability, fair outcomes, recursion, sequences, series, algorithms for computation. PREREQ: MAT 2210 or MAT 2150 and MAT 2300.

**MAT 3500. Teaching Mathematics with Technology (2 credits)**

The application of computer software and other technologies specifically used in the mathematics classroom, with their inclusion in appropriate lesson plans. Classroom management of instructional technology will be emphasized. This course is designed as a preservice course for teachers and may not be used as an advanced MAT or CSC requirement. PREREQ: Permission of instructor.

**MAT 3600. Connections in Mathematics II (1 credit)**

This seminar course is designed to help mathematics and mathematics education majors connect and deepen their mathematical understandings of proof. Emphasis will be placed on research and communication of mathematical ideas. Major course work will include production of portfolio artifacts that represent the major's development of understanding in the mathematics curriculum. PREREQ: MAT 2300, 2600; PREREQ/COREQ 3150.

**MAT 3750. Methods for Teaching Algebra (3 credits)**

Designed to deepen and expand the student's knowledge of methods, materials, and assessment practices related to teaching algebraic concepts at the middle and secondary level. This course is designed as a pre-service course for teachers and may not be used as an advanced MAT or CSC requirement. PREREQ: MAT 2500.

**MAT 4000. Methods of Teaching Mathematics in Middle Grades and Secondary Schools (EDN 4000) (3 credits)**

Presents modern techniques, methods, materials, and assessment practices in the teaching of mathematics. Directed observation in middle or high school mathematics classes. Laboratory work provides experience in developing lesson plans that utilize materials and methods appropriate for classroom use. *NOTE: This course should precede teaching internship by no more than one academic year.* PREREQ: MAT 2500.

**MAT 4020. A Historical Development of Mathematics (3 credits)**

A study of the development of mathematics in its historical setting from its earliest beginnings to modern times. Note: This course may not be used as an Advanced Mathematics requirement for the major in Mathematics. PREREQ: MAT 2210 or 2150.

**MAT 4110. College Geometry (3 credits)**

A rigorous development of metric and synthetic approaches to Euclidean and non-Euclidean geometries using an axiomatic format. Similarities and differences among definitions, axioms, theorems, and postulates of non-Euclidean geometries will be considered. The relationship of these geometries to Euclidean geometry will also be studied. PREREQ: MAT 2300; PREREQ or COREQ: MAT 3150.

**MAT 4150. Theory of Numbers (3 credits)**

An introduction to the properties of integers, prime and composite numbers, Fermat's Theorem, arithmetic functions, quadratic residues, Diophantine equations, continued fractions and congruences. PREREQ: MAT 2210 or 2150.

**MAT 4220. Applied Mathematics (3 credits)**

Introduction to mathematical modeling. Techniques and properties of discrete and continuous models. Case studies. PREREQ: MAT 3150 and MAT 3320.

**MAT 4310. Real Analysis I (3 credits)**

An introduction to modern mathematical analysis with careful attention to topics of elementary and intermediate calculus of one or more variables. Topics include convergence of sequences and series, mean value theorems, the Cauchy criterion, integrability. PREREQ: MAT 2300 and 3310.

**MAT 4320. Real Analysis II (3 credits)**

A continuation of Advanced Calculus I including such topics as the total derivative of multi-variable functions, transformations of  $\mathbb{R}^n$ , representations of functions by series and integrals, and uniform convergence. PREREQ: MAT 4310.

**MAT 4440. Complex Analysis (3 credits)**

Complex numbers, analytic functions, conformal mappings, contour integration, Cauchy's theorem and integral formula. Taylor and Laurent expansions, analytic continuation, and Liouville's theorem. PREREQ: MAT 3310.

**MAT 4490. Internship in Mathematics in the Secondary School (9 credits)**

Provides a semester-long full-time teaching experience in an off campus public school setting. Pass/Fail grading. PREREQ: MAT 4000

**MAT 4600. Connections in Mathematics III (1 credit)**

This seminar course is designed to help mathematics and mathematics education majors connect and deepen their mathematical understandings of advanced analysis and technology. Emphasis will be placed on research and communication of mathematical ideas. Major course work will include production of portfolio artifacts that represent the major's development of understanding in the mathematics curriculum. PREREQ: MAT 3600.

**MAT 4750. Professional Seminar in Secondary Mathematics (3 credits)**

A seminar designed to parallel the full-semester student teaching experience. Emphasis will be placed on the appropriate application of methods of teaching and assessment in a clinical setting. Proper

use of instructional materials, participation in the reflective teaching process, and opportunities for professional development and growth will be emphasized. PREREQ: Admission to Professional Semester.

**MAT 4990. Independent Study (1-3 credits)**

Offered for mathematics majors on approval of the Department Chair.

**MATS 4xxx. Special Topics (Variable Title) (1-3 credits)**

A study of special topics in mathematics or mathematics education. May be repeated to a maximum of 6 hours. PREREQ: Permission of instructor.

**COMPUTER SCIENCE (CSC)****CSC 1000. Introduction to Computers (3 credits)**

This course covers basic office applications using a project-based, hands-on approach. The applications covered include each of the following: word processor, spreadsheet, database software, presentation software, and desktop publishing software.

**CSC 1300. WWW Information (3 credits)**

Introduces students to the World Wide Web, focusing on the techniques of web page creation. No programming background is required, although students will learn some programming through scripting languages.

**CSC 1750. Introduction to Algorithms (3 credits)**

Introduces a two-part survey of computing applications and algorithmic principles. This course introduces the range of algorithmic concepts and constructs in a particular programming language. The follow-on course, CSC 185, extends the conceptual foundation and expands the programming language context. Topics include data representation, simple I/O, arrays, subprograms, searching, sorting, and merging. Techniques of problem solving, stepwise refinement, and documentation are also covered. COREQ: CSC 1760

**CSC 1760. Introduction to Programming (3 credits)**

This is an intense course in programming implementing concepts of structured programming and algorithmic analysis with emphasis on application. COREQ: CSC 1750.

**CSC 1850. Object-Oriented Programming (3 credits)**

Builds on the foundation provided by CSC 1750 to provide students with immersion in programming experience and associated techniques, with a focus on the object oriented paradigm. Topics include control flow, debugging and testing, string processing, searching and sorting, recursion, and stacks and linked lists. Emphasis on effective software engineering practices, including incremental development, systematic testing, and hypothesis driven debugging of software artifacts. PREREQ: MAT 1090 or MAT 1070 and C or better in CSC 1750 and CSC 1760.

**CSC 1900. JAVA Programming (3 credits)**

A first course in programming Java using concepts of structured programming and algorithmic analysis with emphasis on application. PREREQ: CSC 1750 and 1760.

**CSC 2020. Microcomputer Programming (3 credits)**

A first course in microcomputer programming emphasizing both numeric and string processing, and structured programming. (Visual BASIC and Delphi) using IBM compatible computers. PREREQ: CSC 1000 or permission of instructor.

**CSC 2050. Introduction to Programming—C/C++ (3 credits)**

A first course in programming covering the basic concepts of C and C++ programming languages. Covers structured programming, object-oriented programming, and algorithmic analysis with emphasis on application.

**CSC 2150. Discrete Structures (3 credits)**

Offers an intensive introduction to discrete mathematics as it is used in computer science. Topics



include functions, relations, sets, propositional and predicate logic, simple circuit logic, proof techniques, elementary combinatorics, and discrete probability. PREREQ: MAT 1070 or MAT 1090 or MAT 2210 and CSC 1750, 1760.

### **CSC 2250. Fundamentals of Computer Systems (3 credits)**

Introduces the student to computer hardware and software interfaces. Topics include computer structure, machine language, assembly language, addressing modes, file structures, I/O, memory management, and assemblers, linkers, and loaders. PREREQ: CSC 2150 and CSC 1850. [CSC 1850 is a corequisite with a B or better in CSC 1750.]

### **CSC 2260. Operating Systems and Networking (3 credits)**

Introduces the fundamentals of operating systems together with the basics of networking and communications. PREREQ: C or better in CSC 1750 and 1760.

### **CSC 2650. Digital Logic (3 credits)**

Covers basic concepts of computer engineering and science from digital logic circuits to the design of a complete microcomputer system, presenting an understanding of principles and basic tools required to design typical digital systems such as microcomputers. PREREQ: C or better in CSC 2150.

### **CSC 2850. Data Structures (3 credits)**

Design of algorithms. Graphs, paths, and trees. Analysis of algorithms for internal and external sorting, searching, and merging. Hashing. Algorithms for dynamic storage allocation. PREREQ: CSC 2150 and C or better in CSC 1850.

### **CSC 2920. Software Development and Professional Practices (3 credits)**

The course material combines a range of topics integral to the design, implementation, and testing of a medium scale software system with the practical experience of implementing such a project as a member of a programmer team. In addition to material on software engineering, this course also includes material on professionalism and ethical responsibilities in software development and human-computer interaction. PREREQ: CSC 1850.

### **CSC 3350. Network Management (3 credits)**

Presents the five conceptual areas of network management as defined by the International Organization for Standardization (ISO): performance management, configuration management, accounting management, fault management, and security management. This course covers networking technologies such as Ethernet, bridges, and switches. It addresses network management architectures and protocols to lay the foundation for SNMP management, broadband management, and TNM. Some network management applications, tools to monitor network parameters, and network management systems to manage networks are included. PREREQ: CSC 1850, 2260.

### **CSC 3380. Programming for the World Wide Web (3 credits)**

In this course, students will gain experience with the programming techniques, technologies, and issues associated with the Internet. Topics include network programming with sockets, TCP/IP, the HTTP protocol, web-servers, browsers, security, authentication, distributed objects, and client-server computing. This is a project-oriented course in which students will be expected to develop software using a variety of programming languages. PREREQ: CSC 1850 or 1900 and CSC 2260.

### **CSC 3650. Introduction to Computer Architecture (3 credits)**

Introduces students to the organization and architecture of computer systems, beginning with the standard von Neumann model and then moving forward to more recent architectural concepts. PREREQ: CSC 2650 and CSC 2250.

### **CSC 3750. Programming Languages (3 credits)**

This is an introduction to the design and implementation of programming languages, including a survey of several major languages and their features. Material covered will emphasize implementation details. PREREQ: CSC 2250.

**CSC 3800. Database Management Systems (3 credits)**

The course covers the goals of DBMS including data independence, relationships, logical and physical organizations, schema, and subschema. Hierarchical, network, and relational models are covered with an emphasis on the relational model. Small SQL queries are created and examined. PREREQ: CSC 2850.

**CSC 3910. Software Engineering (3 credits)**

Software Engineering is the study of the software process, in particular the analysis, design, implementation, testing, maintenance, and documentation of a software system. This course introduces the fundamental software engineering concepts and terminology, presents formal models of structured design and programming, and aims to give students both a theoretical and a practical foundation. The primary focus of the class will be on learning modern software methods and tools that can be applied on a project in CSC 4900. Topics covered include information hiding, iterative enhancements, structured programming teams, program libraries, walkthroughs, and documentation. PREREQ: CSC 2920.

**CSC 3920. Software Process Improvement (3 credits)**

This course is an introduction to the CMMI framework, emphasizing understanding, evaluation, and integrated process improvement. Topics include software process assessment, the Capability Maturity Model for Software, other approaches to software process assessment. This course presents a survey on the use of SPI and software process assessment (SPA) as practiced by large and small companies. PREREQ: CSC 3910.

**CSC 3930. Component-Based Computing (3 credits)**

Analyzes the fundamental problems that must be solved by middleware in order to provide complete and transparent interoperability between distributed components. The course illustrates the state of the art with respect to how the fundamental problems are solved in practice and provides a hands-on experience developing distributed applications using the most important standards. PREREQ: CSC 3910.

**CSC 4010. Theory of Computation (3 credits)**

Introduces the student to formal language theory, finite automata, regular expressions, and regular grammars; pushdown automata; context free grammars; and context sensitive grammars. PREREQ: CSC 2250, CSC 2850.

**CSC 4020. Introduction to Computer and Network Security (3 credits)**

This course provides an introduction to the theory and application of security in computer and network environments. Students will develop the skills necessary to address the security needs of enterprise and personal environments. The course covers cryptography, authentication, access control, security in operating systems, network security, and denial-of-service. Course projects will focus on the application of security tools to real world problems. PREREQ: CSC 2260.

**CSC 4050. Current Topics in Computers in Education (3 credits)**

The application of computer software in the classroom, including integration of software with lesson plans. Additional topics include matching software to the most appropriate hardware. This course is designed as a pre-service course for teachers and may not be used as an advanced MAT or CSC requirement. It is not to be counted toward the Mathematics Concentration at the Graduate level. PREREQ: Permission of instructor.

**CSC 4150. Translators and Compilers (4 credits)**

This course covers interpreters, assemblers, and compilers. The student will study grammar, languages, syntax, semantics, and BNF. Course material covers parsing, symbol tables, one- and two-pass compilers, and code generation. The course has a programming project. Credit, 4 semester hours. PREREQ: CSC 4010.

**CSC 4350. Operating Systems (3 credits)**

This course covers the basic functions of an operating system. Topics covered include process manage-

ment and scheduling, memory management and paging algorithms, I/O management, file management, deadlock, and operating system security. PREREQ: MAT 2220.

**CSC 4360. Mainframe Computing (3 credits)**

This course covers the basic features of the mainframe computer. It builds on previous introductory courses in computer system concepts, such as computer organization and architecture, operating systems, data management, or data communications. Topics covered include mainframe hardware systems, Job Control Language (JCL), System Display and Search Facility (SDSF), Time Sharing Options and Extensions (TSO/E), Batch Processing, Interactive Systems, Linux, and other related topics. PREREQ: CSC 4350

**CSC 4450. Design and Analysis of Algorithms (3 credits)**

This course covers time and space complexity of algorithms. Survey of various design techniques such as “divide and conquer” and the “greedy” method is covered. Program verification and validation as well as NPComplete and NPHard problems are discussed. PREREQ: CSC 2850, and MAT 2220.

**CSC 4810. Data Mining (3 credits)**

This course covers the principles underlying data mining algorithms and their applications. Algorithms that include trees and rules for classification and regression, association rules, belief networks, classical statistical models, nonlinear models such as neural networks, and local “memory-based” models are presented and examined. Examples showing how all of the preceding analysis fits together are presented. Topics include the role of metadata, how to handle missing data, and data preprocessing. PREREQ: CSC 3800.

**CSC 4820. Data Warehousing (3 credits)**

The basic elements of data warehousing are described. Topics of project management, defining business requirements, the architecture and infrastructure, the role of metadata, implementation, growth, and maintenance are covered. PREREQ: CSC 3800.

**CSC 4900. Advanced Software Project (4 credits)**

An assigned, group or individual, in-depth programming project includes problem definition, requirements analysis, design, implementation, documentation, and testing. PREREQ: CSC 2250 and CSC 2850.

**CSC 4970. Computer Science Internship (1-3 credits)**

Fully declared undergraduates in Computer Science who have completed CSC 2850 and are in good standing (at least a 2.5 GPA) are eligible for internships in business and industry. This is a pass/fail course. The course may be repeated, but no more than three hours will be applied as an elective for all Computer Science Areas of Emphasis. Detailed requirements and application form are maintained by Coordinator of CS/IT Internships. PREREQ: CSC 2850 and approval of Department Chair.

**CSC 4990. Independent Study (1-3 credits)**

Open to seniors in Computer Science with a quality point average of 3.0 in the major and with approval of the Department Chair. Written and oral reports are required.

**CSCS 4xxx. Special Topics (Variable Title) (3 credits)**

A study of special topics in computer science. The selected topics will be an in-depth study of a content area, or they will be selected over the breadth of a content area. PREREQ: Permission of instructor.

**INFORMATION TECHNOLOGY (ITC)****ITC 2060. Human–Computer Interaction (3 credits)**

This course provides students with a comprehensive account of the field of human–computer interaction (HCI). HCI is a multidisciplinary field of study concerned with how humans interact with software and hardware interfaces. The interplay between people and computers in applications such as multimedia, virtual environments, and computer supported cooperative work, will be investigated. Theories of human information processing, human behavior, and their implications for user-centered

design of interfaces are explored. Students learn principles and guidelines needed to develop high quality interface designs that users can understand, predict, and control. The application of the usability engineering process, including analysis, design, prototyping and testing will new studied. PREREQ: CSC 1750 and 1760 or CSC 2050.

### **ITC 2080. Introduction to System Administration and Shell Scripting (3 credits)**

This course provides students with tools and techniques used in administration of computing systems. Unix/Linux and Windows will be among systems studied. Topics covered include file systems, files security, editors, file processing, shell scripting programming, and system utilities. Students will learn system installation, halting and booting the system, file and directory permission structures, print and disk quotas, device configuration and management, and user account administration. Students also explore tools and techniques used to script common tasks in operating system environments. Students will gain experience in writing scripts in Unix/Linux and Windows operating systems. PREREQ: CSC 1750 and 1760 or CSC 2050.

### **ITC 2700. Computer Network and Data Communication (3 credits)**

This course introduces students to the fundamentals of computer networks, data communications hardware and software, and use of these components in computer networks. Students will investigate issues of networking from the lowest levels of data transmission and wiring to the highest levels of application software, explaining how underlying technologies provide services and how Internet applications use those services. Topics covered include OSI model, LAN, WAN, packet transmission, internetworking, TCP/IP, WWW, Java technology, network control, and performance considerations. PREREQ: CSC 1750 and 1760 or CSC 2050.

### **ITC 3100. Website Development and Multimedia (3 credits)**

This course builds on the basic aspects of XHTML, Internet, and Web technologies as well as computer-mediated communication, and basic Internet applications such as telnet, FTP, and WWW techniques. Students are assumed to have had experience in Web page development and publishing. Topics covered in this course include fundamental Web design concepts such as usability, accessibility, information design, and graphic design in the context of the Web. User-centered Web design and development, definition of the site mission and the target user population, methods for gathering requirements, conceptual design of Web site, site architecture, page layout, physical design, usability testing, implementation, marketing, maintenance, and evaluation will also be explored. This course also provides introduction to multimedia (audio, video, as well as speech synthesis and recognition), and multimedia programming, cascading style sheets, and DHTML. PREREQ: CSC 1300.

### **ITC 3250. System Administration (3 credits)**

This course introduces students to the essential knowledge and skills that system administrators possess. This course reviews the basic operating system concepts, including process and thread management, memory management, file systems, and input/output systems as well as various administration services. It covers system administration topics focuses on integrating systems and user support services. Topics explored include security, user and group administration, system update and maintenance, backup and restore technologies, as mass storage technologies. PREREQ: ITC 2080 and 2700.

### **ITC 4100. Web Database Development (3 credits)**

This course builds on the distributed client/server DBMS and Web technologies. Web client-side, database server-side, and web-server side issues associated with a three-tier DBMS implementation will be investigated. Students will implement a three-tier DBMS application. A database backend will be designed and implemented using a standard DBMS product and the Open Source DBMS Software. Students will construct a web server and implement client/server connectivity. Students will develop tools to monitor and measure performance of an implementation. Programming projects are required. PREREQ: CSC 3800 and ITC 3100.

### **ITC 4200. Windows and Game Programming (3 credits)**

This course provides students with Windows programming techniques, and explores game program-

ming skills and strategies. Students will learn how to develop stand alone applications windows, dialog boxes, option buttons, check boxes, menus, help facilities. It also covers DLL (dynamic link libraries), and how to use Windows API (application program interface), DDE (dynamic data exchange), and multimedia application. PREREQ: CSC 1750 and 1760 or CSC 2050.

**ITC 4800. Advanced Computer Systems (3 credits)**

This course explores topics focused on services in an enterprise environment characterized by a high degree of complexity, large scale, and heterogeneity. It discusses topics such as computational and data grid computing, cluster computing, the role of Information Technology in large organization, and virtualization of services. PREREQ: ITC 2080 and 2700.

**ITC 4940. Capstone Project in Information Technology (4 credits)**

Capstone IT project to be taken by graduating students in the Information Technology curriculum. PREREQ: Senior standing in BSIT.

**ITC 4950. Independent Study in Information Technology (3 credits)**

Students will work independently under the supervision of a faculty advisor on a topic not covered in other courses. Proposal must be approved and signed by a faculty member. PREREQ: Permission of instructor.

**ITC 4960. Information Technology Internship (1-3 credits)**

Fully declared undergraduates in Information Technology who have completed CSC 2850 and are in good standing (at least a 2.5 GPA) are eligible for internships in business and industry. This is a pass/fail course. The course may be repeated, but no more than three hours will be applied as an elective for all Information Technology Areas of Emphasis. Detailed requirements and application form are maintained by Coordinator of CS/IT Internships. PREREQ: CSC 2850 and approval of the Department Chair.

**ITCS 4xxx. Special Topics in Information Technology (3 credits)**

Current topics and advances in Information Technology are studied. PREREQ: Permission of the instructor.

**GRADUATE COURSES**

See the School of Graduate Studies and Research section of the Catalog.