

## **MATHEMATICS, COMPUTER SCIENCE, & STATISTICS (Updated May 2020)**

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### **Mathematics & Statistics**

#### **Mission Statement:**

The mission of the Bachelor of Science program in mathematics is to impart the knowledge, practice, and communication of mathematics and statistics to our students.

#### **Requirements for the Bachelor of Science Degree in Mathematics**

The Department of Mathematics and Computer Science offers three programs of study leading to a baccalaureate degree in mathematics: pure mathematics, teacher licensure, and statistics. The Department also offers minors in mathematics and statistics. A certificate in statistics is also available. Courses in mathematics and statistics are designed to meet the needs and interests of students who plan to teach mathematics in elementary, middle and secondary schools, to give students a strong foundation for graduate study, and to prepare students for employment in business and industry. Mathematics and statistics courses are designed to provide cultural benefits to all students by improving reasoning and problem-solving skills, as well as providing the necessary mathematical foundation for students in business, pre-engineering, and science. Our programs have been developed using guidelines from the Mathematical Association of America, the National Council of Teachers of Mathematics, and the American Statistical Association.

**Candidates for this degree must meet all academic requirements stated in the catalog under which they were admitted to the University or a later catalog.** In addition to the courses listed below for a Bachelor of Science degree in Mathematics, all students must complete the Liberal Arts Core requirements as specified by the University. Note that the courses specified below for mathematics and science can be counted as meeting the Liberal Arts Core requirements for courses in their respective areas. To take any course in mathematics, computer science, or statistics listing a prerequisite, the prerequisite must be passed with a grade of C or better, or the student must have departmental approval. Students must have a grade of C or better in all courses in major and minor fields and also in the courses listed as “additional requirements.” Note that a minor is required for the Pure Mathematics and the Statistics tracks but not for the Teacher licensure track.

#### **Pure Mathematics Program of Study**

<b>Mathematics Core</b>	<b>Hours</b>
MTH 1294	Calculus I .....4
MTH 2044	Calculus II .....4
MTH 2283	Discrete Mathematics .....3
MTH 3104	Calculus III.....4
MTH 4133	Algebraic Structures I .....3
MTH 3163	Probability and Statistics.....3
MTH 3113/3663	Linear Algebra or Applied Linear Algebra .3
MTH 3573	Transition to Advanced Mathematics.....3
MTH 4901	Senior Project.....1
	Junior-Senior MTH/STA Electives or STA 2323 or STA 2053 .....12

At most three total credit hours of MTH, CSC, or STA internship can be used as electives.

### **Additional Requirements**

ENG 3613      Technical Writing  
CSC 1104      Foundations of Computer Science I  
BIO 1013/1021    Introduction to Biology/Lab  
CHM 1014      University Chemistry I  
PHY 2234      University Physics I

One of the following:

BIO 2104      General Botany  
BIO 2114      General Zoology  
CHM 1024      University Chemistry II  
PHY 2244      University Physics II

### **Teacher Licensure Program of Study**

<b>Mathematics Core</b>		<b>Hours</b>
MTH 1294	Calculus I .....	4
MTH 2044	Calculus II.....	4
STA 2323	Statistical Methods.....	3
MTH 2283	Discrete Mathematics.....	3
MTH 3023	Systems of Geometry I.....	3
MTH 3104	Calculus III.....	4
MTH 3163	Probability and Statistics I .....	3
MTH 3383	Math for Secondary Teachers .....	3
MTH 3113/3663	Linear Algebra or Applied Linear Algebra ....	3
MTH 3573	Transition to Advanced Mathematics.....	3
MTH 4133	Algebraic Structures I .....	3
MTH 4893	Special Methods - Mathematics .....	3
	Junior-Senior MTH/STA Elective .....	3
MTH 4901	Senior Project.....	1

### **Additional Requirements**

ENG 3613      Technical Writing  
CSC 1104      Foundations of Computer Science I  
Professional Education Curriculum for 7-12 teachers.

*\*Students in the 7-12 mathematics teacher licensure program do not have to complete a minor.*

## Statistics Program of Study

<b>Mathematics Core</b>		<b>Hours</b>
MTH 1294	Calculus I .....	4
MTH 2044	Calculus II.....	4
STA 2323/2053	Statistical Methods or Applied Biostatistics ..	3/4
MTH 2283	Discrete Mathematics.....	3
MTH 3104	Calculus III.....	4
MTH 3113/3663	Linear Algebra or Applied Linear Algebra ...	3
MTH 3163	Probability and Statistics 1.....	3
MTH 3573	Transition to Advanced Mathematics .....	3
MTH 4901	Senior Project.....	1
	Junior-Senior STA electives .....	9
	Statistics electives .....	6

*Statistics electives for this track cannot include courses already required for the core courses in the program of study.* At most three total credit hours of MTH, CSC, or STA internship can be used as electives.

### **Additional Requirements**

ENG 3613	Technical Writing
CSC 1104	Foundations of Computer Science I
BIO 1013/1021	Introduction to Biology/Lab
CHM 1014	University Chemistry I
PHY 2234	University Physics I

One of the following:

BIO 2104	General Botany
BIO 2114	General Zoology
CHM 1024	University Chemistry II
PHY 2244	University Physics II

### **Statistics Electives**

At most one course outside the Mathematics, Computer Science, and Statistics Department can be counted as a statistics elective. Courses already required for a major in mathematics or computer science cannot be used as electives for a minor in statistics. Only one of MTH 2283 and PHI 2133 can be used as an elective for the minor; only one of MTH 1294 and MTH 2553 can be used as an elective for the minor; PHI 2133 cannot be used for a major in the statistics track.

CSC 1104	Foundations of Computer Science I
CSC 1114	Foundations of Computer Science II
CSC 2203	Data Structures
CSC 3133	Introduction to Database Theory
CSC 3223	Algorithm Analysis
CSC 4213	Simulation Theory
CSC 4261-6	Computer Science Internship

MTH 1294	Calculus I
MTH 2044	Calculus II
MTH 2283	Discrete Mathematics
MTH 2553	Survey of Calculus
MTH 3104	Calculus III
MTH 3113/3663	Linear Algebra or Applied Linear Algebra
MTH 3573	Transition to Advanced Mathematics
MTH 4124	Differential Equations
MTH 4233	Advanced Calculus I
MTH 4303	Advanced Calculus II
MTH 4373	Numerical Analysis
MTH 4261-6	Mathematics Internship
DSC 3153	Data management
DSC 3163	Data Visualization
DSC 4043	Systems Analysis and Design
DSC 4163	Prescriptive Analytics
DSC 4173	Data Mining
DSC 4253	Predictive Analytics
PHI 2133	Logic I
PHI 4143	Logic II
PSY 4343	Advanced Statistics
PSY 4433	Psychological Tests and Measurements
SOC 4213	Research Methods
STA 2053	Applied Biostatistics
STA 3443	Statistical Computing
STA 3163	Probability and Statistics I
STA 4013	Applied Regression Analysis
STA 4023	Applied Analysis of Variance
STA 4033	Nonparametric Statistical Methods
STA 4043	Statistical Analysis of Time Series
STA 4261-6	Statistics Internship
STA 4433	Probability and Statistics II
STA 4171-3	Special Topics in Statistics

### **Statistics Minor Requirements - 18 Hours** (*minimum*)

The minor in statistics requires STA 2323 (Statistical Methods), STA 2053 (Applied Biostatistics), or a substitute approved by the department and 15 more hours from the list of Statistics Electives. Students in the pure mathematics track can minor in statistics, but no elective can apply to both the major and the minor. At least ~~three~~ nine hours of the electives must have a STA prefix and be at the junior-senior level. At most three total credit hours of MTH, CSC, or STA internship can be used as electives.

### **Mathematics Minor Requirements- 17 Hours** (*minimum*)

The minor in mathematics requires 17 hours of MTH or STA courses at or above Calculus I (MTH 1294). At least one three-credit MTH or STA course at the junior or senior level is required. Mathematics courses specifically designed for elementary or middle-level education will not be counted towards a minor in mathematics. At most three total credit hours of MTH, CSC, or STA internship can be used as electives.

### **Middle School Mathematics**

The program and degree for Middle-Level Math/Science Licensure are through Teachers College, Henderson. However, the following mathematics courses required for this program are taught in the Department of Mathematics, Computer Science, and Statistics.

MTH 1053	Number Operations & Number Sense
MTH 1213	Algebra for Elementary & Middle Grades
MTH 2483	Geometry 1 for Elementary & Middle Grades
MTH 2543	Data Analysis, Statistics and Probability for the ..... Elementary and Middle Grades
MTH 2553	Survey of Calculus
MTH 3633	Advanced Mathematics for Middle Grades
MTH 3553	Foundations of Calculus for Middle Grades
MTH 4563	Math Modeling and Applications for Middle Grades

### **Certificate in Statistics**

A certificate in statistics requires 12 hours from the following courses. You may take the statistics courses or the mathematics elective in an online format with instructor approval.

Choose at most one:

- STA 2323 Statistical Methods or substitute approved by department
- STA 2053 Applied Biostatistics

Choose at least two at least six hours:

- STA 3443 Statistical Computing
- STA 4013 Applied Regression Analysis
- STA 4023 Applied Analysis of Variance
- STA 4033 Nonparametric Statistical Methods
- STA 4043 Statistical Analysis of Time Series
- STA 4463 Probability and Statistics II
- STA 4171-3 Special Topics in Statistics

Choose at most one:

- CSC 1104 Foundations of Computer Science I
- CSC 1114 Foundations of Computer Science II
- CSC 2203 Data Structures
- CSC 3133 Introduction to Database Theory
- CSC 3223 Algorithm Analysis
- CSC 4213 Simulation Theory
- MTH 3163 Probability and Statistics I

## Computer Science

The Department of Mathematics, Computer Science, & Statistics offers programs of study leading to a Bachelor of Science degree in computer science and a minor in computer science. The program is based upon guidelines as specified in the latest report by The Joint Task Force on Computing Curricula of the IEEE Computer Society and The Association for Computing Machinery. The department regularly reviews and adapts the program to ensure that it continues to satisfy these guidelines, but also meets the needs of the students and the organizations of which they will be part. By staying abreast of changes in the industry, the faculty is able to incorporate new technologies and ideas into the program and to provide students with a solid foundation on which they can build during their careers. Throughout the program, the theoretical concepts of computer science as well as the practical issues of implementation are stressed. Emphasis is placed on the "complete" problem-solving process.

The mission of the computer science program is to provide its majors with the expertise to become leaders and innovators in information technology and to produce graduates that will be successful professionals, be committed to lifelong learning, and make positive contributions to society.

Successful computer science graduates find themselves faced with a variety of career paths. These include application/system programmers, systems analysts, software engineers, database management administrators, and network administrators to name a few. Students receive a solid foundation preparing them for these choices through the computer science core courses. This core consists of courses in programming concepts, data structures, algorithms, software engineering, database management systems, architecture, operating systems, formal languages and programming languages.

A student's knowledge of the computing discipline is also supplemented with additional elective course work. This can include courses in communication and networking, interfacing and machine control, machine intelligence, visual programming, graphics, electronics, compiler theory, and client/server programming among others. Other requirements for the degree include a number of mathematics and science courses as well as the liberal arts core. Additional hours are also required in the areas of written and verbal communication. Collectively, these courses provide a computer science graduate with the necessary foundation to either enter the job market or pursue an advanced degree.

### Requirements for a Bachelor of Science Degree in Computer Science

To obtain a Bachelor of Science degree in computer science students must complete at least 120 semester hours of college-level academic work. Students who enter the program adequately prepared can complete degree requirements over the course of eight semesters. Others, however, may require additional time. This is usually the case for students needing preparatory courses or for those taking course loads lighter than that listed here. Consultation with academic advisors assists students in preparing a plan of study that will enable the student to obtain the degree within the confines of the academic requirements as well as their own personal objectives.

In addition to the courses listed below for a Bachelor of Science degree in Computer Science, all students must complete the Liberal Arts Core requirements as specified by the University. Note that the courses specified below for mathematics and science can be counted as meeting the Liberal Arts Core requirements for courses in their respective areas

### Computer Science Core

CSC	1104	Foundations of Computer Science I .....	4
CSC	1114	Foundations of Computer Science II .....	4
CSC	2173	Assembler Language .....	3
CSC	2203	Data Structures .....	3
CSC	3223	Algorithm Analysis .....	3
CSC	3443	Computer Organization .....	3

CSC	3453	Programming Languages .....	3
CSC	3193	Operating Systems .....	3
CSC	3133	Database Theory .....	3
CSC	3463	Software Engineering .....	3
CSC	3433	Computational Complexity .....	3
CSC	3472	(WI) Technology and Society .....	2
CSC	4483	Capstone .....	3

## Computer Science Electives

Jr/Sr Computer Science Courses ..... 9

### Mathematics

MTH	2283	Discrete Mathematics † .....	3
MTH	1294	Calculus I .....	4
MTH	2044	Calculus II .....	4
STA	2323	Statistical Methods* .....	3

Jr/Sr Mathematics ..... 3

\*May substitute MTH 3163 – Probability and Statistics I

### Science

CHM	1014/1024	University Chemistry I/II <b>or</b>
PHY	2034/2044	General Physics I/II <b>or</b>
PHY	2234/2244	University Physics I/II

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### Other

ENG	3613	Technical Writing .....	3
COM	3813	Business and Professional Communication ..	3

## Requirements for a Minor in Computer Science

In addition to the Bachelor of Science in Computer Science degree, the Department also offers a minor in computer science. The minor is structured to provide the student with a basic foundation of computer programming and supplies exposure to more advanced computing concepts through elective courses. Students seeking a minor in computer science are encouraged to consult with the academic advisors in the Department to customize the program to satisfy their needs.

## Computer Science Core

CSC	1104	Foundations of Computer Science I .....	4
CSC	1114	Foundations of Computer Science II .....	4
CSC	2203	Data Structures .....	3

## Computer Science Electives

Jr/Sr Computer Science ..... 6

## Mathematics

MTH 2283 Discrete Mathematics ..... 3

## Courses in Mathematics

**MTH 0003. Elementary Algebra.** This course is designed for students who desire or need a stronger understanding of the numeration system and how to operate within that system. It is designed to enhance students' understanding of algebraic expressions and equations. Students will analyze functions using graphical and algebraic techniques. Students with a mathematics ACT score below 17 (or equivalent score on admission exams approved by HSU) are required to complete the course with a grade of C or better before enrolling in MTH 0013. This course cannot be used for degree requirements.

**MTH 0013. Intermediate Algebra.** This course is designed to strengthen basic algebraic manipulation skills. The course develops the characteristics of linear and quadratic functions to solve equations, systems of equations and inequalities. Prerequisite: MTH 0003 (with a grade of C or better), or a mathematics ACT score of at least 17 (or equivalent score on an admission exam approved by HSU). This course cannot be used for degree requirements.

**MTH 0032. Quantitative Literacy Review.** Students will learn and review basic mathematical concepts as well as calculator skills that are needed to succeed in Quantitative Literacy. Students must be enrolled in MTH 1033 (Quantitative Literacy) to enroll in MTH 0032. This course is required for students whose ACT mathematics score is below 19 who are enrolled in MTH 1033, but is open to any student enrolled in MTH 1033.

**MTH 0242. College Algebra Review.** Students will learn and review basic mathematical concepts as well as calculator skills that are needed to succeed in College Algebra. Students must be enrolled in MTH 1243 (College Algebra) to enroll in MTH 0242. This course is required for students who are enrolled in MTH 1243 whose ACT mathematics score is 17, 18 or 19, but is open to any student enrolled in MTH 1243. Students must enroll with the same instructor for both College Algebra and College Algebra Review.

**MTH 1033 (MATH 1003). Quantitative Literacy.** This course consists of units dealing with logic, proportional reasoning, the mathematics of finance, exponential growth and decay, geometry (plane and solid), voting theory, applications of mathematics to music and art, and probability and statistics. Prerequisite. A mathematics ACT score of at least 19 OR concurrent enrollment in MTH 0032 OR a C or better in MTH 0003.

**MTH 1034. Quantitative Literacy - Enhanced.** This course consists of units dealing with logic, proportional reasoning, the mathematics of finance, exponential growth and decay, geometry (plane and solid), voting theory, applications of mathematics to music and art, and probability and statistics. Meets three hours plus an additional two-hour laboratory per week. Prerequisite: MTH 0003 (with a grade of C or better), or a mathematics ACT score of at least 17 (or equivalent score from an admission exam approved by HSU).

**MTH 1053. Number Operations and Number Sense.** Numeration systems from natural numbers through real numbers will be developed including operations and properties with applications using the mathematical practices and supported by varied representational tools, including concrete models as appropriate to the P-8 teacher. Prerequisites: Mathematics ACT score of at least 19 (or equivalent math score from an admission exam approved by HSU) or a grade of C or better in either MTH 1244, MTH 1243, or MTH 1274.



**MTH 1083 (MATH 1003). Mathematics through Practical Applications.** This is a course designed to meet the general education needs of students majoring in programs that do not require college algebra or more advanced courses. Topics include percentages, calculating and using statistics, unit conversions, mathematical modeling, physics of motion, probability, geometry, estimation, data collection and other applications to everyday life. Examples will come from various areas chosen by the instructor such as sports, music, art, physics, acoustics, etc. Prerequisite: MTH 0003 (with a grade of C or better), or a mathematics ACT score of at least 19 (or equivalent score from an admission exam approved by HSU).

**MTH 1213. Algebra for Elementary and Middle Grades.** A course designed to meet the needs of students preparing for elementary and/or middle school licensure. Topics include linear and non-linear equations, linear inequalities; inverse, polynomial, rational, exponential and logarithmic functions. Concepts will be developed using appropriate manipulatives and technology. Prerequisite: MTH 0013 (with a grade of C or better), or a mathematics ACT score of at least 19 (or equivalent math score from an admission exam approved by HSU). An ACT math score of 22 or above is recommended.

**MTH 1233. Applied Trigonometry.** Emphasis on applications instead of solving trigonometric equations and proving identities. Topics include angular measurement, trigonometric functions, graphing, Law of Sines, Law of Cosines, Heron's formula, polar coordinates, parametric equations, and two- and three-dimensional vectors. Students preparing for MTH 1294 should take MTH 1253 instead. Prerequisite or corequisite: MTH 1213, MTH 1243, MTH 1244, MTH 1273, or departmental permission.

**MTH 1243 (MATH 1103). College Algebra.** A course designed to meet the general education needs of students in business, sciences, and other programs outside of mathematics. Topics include linear, non-linear, inverse, polynomial, rational, exponential and logarithmic functions; systems of linear equations, linear and quadratic inequalities. Problem-solving techniques will be discussed with and without the use of technology. Prerequisites: A mathematics ACT score of at least 20 OR a mathematics ACT score of at least 17 and concurrent enrollment in MTH 0242 OR a C or better in MTH0003 and concurrent enrollment in MTH 0242 OR a C or better in MTH 0013. A mathematics ACT score of 22 or above is recommended.

**MTH 1244. College Algebra-Enhanced.** A course designed to meet the general education needs of students in business, sciences, and other programs outside of mathematics. Topics include linear, non-linear, inverse, polynomial, rational, exponential and logarithmic functions; systems of linear equations, linear and quadratic inequalities. Problem-solving techniques will be discussed with and without the use of technology. Meets three hours plus an additional two-hour laboratory per week. MTH 0003 with a grade of C or better, or MTH ACT of 17 or better.

**MTH 1253 (MATH 1203). Plane Trigonometry.** Topics to include angular measurement, trigonometric functions, identities, graphing, Law of Sines, Law of Cosines, Heron's formula, polar coordinates, complex numbers, vectors, and parametric equations. Prerequisite or co-requisite: MTH 1243 or MTH 1273.

**MTH 1274. Precalculus Mathematics.** Selected topics from algebra, trigonometry, and analytic geometry. Provides necessary background for students who plan to take MTH1294. Prerequisite: Math ACT score of at least 25, or a C or better in MTH 1243 or MTH 1244.

**MTH 1294 (MATH 2405). Calculus I.** Topics include limits, derivatives, and integrals of algebraic and transcendental functions. Theory, computation, and applications are emphasized. Prerequisites: A C or better in MTH 1274 or (MTH 1243 and MTH1253) or (MTH 1244 and MTH 1253) or consent of the department.

**MTH 2044. Calculus II (MATH 2505).** This course is a continuation of MTH 1294-Calculus I. Additional topics will include integration techniques, improper integrals, infinite series, parametric equations and polar coordinates. Theory, computation, and applications are emphasized. Prerequisite: MTH 1294 or consent of the department.

**MTH 2283. Discrete Mathematics.** A study of mathematical structures that are fundamentally discrete rather than continuous in nature. The course includes a study of logic, mathematical writing and proofs, an introduction to set theory, relations, and counting methods. Prerequisites: MTH 1243 or MTH 1274; MTH 1294 recommended.

**MTH 2483. Geometry I for the Elementary and Middle Grades.** Geometry concepts appropriate for P-8 grade levels will be developed. Topics will include appropriate geometric terminology, lines, angles, plane curves, polygons and other plane regions, polyhedra and other space figures, measure, constructions, transformations, congruence, similarity and geometric reasoning. Prerequisites: A grade of C or better in MTH 1053 and in one of the following: MTH 1244, MTH 1243, or MTH 1273.

**MTH 2543. Data Analysis, Statistics, and Probability for the Elementary and Middle Grades.** Concepts of data analysis, statistics, and probability appropriate for P-8 grade levels will be developed using the mathematical practices and supported by appropriate technology and varied representational tools, including concrete models. Topics include univariate and bivariate graphical techniques, measures of center and dispersion, normal distribution, discrete probability with applications, geometric probability with applications, and simulation. Prerequisites: A grade of C or better in MTH 1053 and in one of the following: MTH 1244, MTH 1243 or MTH 1274.

**MTH 2553. Survey of Calculus.** Survey of the basic concepts of calculus, including limits, derivatives and integrals using polynomials, rational functions, exponential and logarithmic functions. Models and applications in a variety of areas will be included. Credit will not be given for both MTH 2553 and MTH 1294. Prerequisite: Math ACT score of 25, or a grade of C or better in MTH 1213, MTH 1243, or MTH 1244.

**MTH 2611-6. Internship in Mathematics.** See MTH 4621.

**MTH 3023. (WI) Systems of Geometry I.** The course introduces the concept of an axiomatic mathematical system through the development of neutral and Euclidean geometries with an emphasis on valid arguments. Non-Euclidean geometry will also be investigated. Prerequisites: MTH 1294 and MTH 2283.

**MTH 3063. Advanced Algebra for the Elementary and Middle Grades.** The course reviews the basic concepts of algebra, use of manipulatives, and the use of technology. Prerequisite: MTH 2483.

**MTH 3073. Geometry II for the Middle Grades (4-8).** An informal study of the concepts of position, shape, size, construction with straightedge and compass, structure of geometry, and measurement. Prerequisite: MTH 2483.

**MTH 3104. Calculus III.** A study of 2-D and 3-D vectors and geometry, vector functions, partial differentiation, multiple integration, Lagrange multipliers, and vector calculus. Prerequisite: MTH 2044.

**MTH 3113. Linear Algebra.** Topics include vector spaces, linear transformations and matrices, sets of linear transformations and matrices, eigenvalues and eigenvectors of linear transformations, and similar matrices. Only one of MATH 3113 and MATH 3663 may be applied to a mathematics, computer science, or statistics degree, track, minor, or certificate. Prerequisites: MTH 1294 and MTH 2283. MTH 3573 is recommended.

**MTH 3124. Differential Equations.** Analytic, approximate, and graphical solutions to ordinary differential equations, the theory of the existence and uniqueness of solutions, and applications of these ideas to the physical sciences. Prerequisite: MTH 2044.

**MTH 3163. Probability and Statistics I.** The course deals with the mathematical theory of probability and application of this theory to statistical inference. Topics include descriptive statistics, independence, conditional probability, expectation, variance, discrete and continuous distributions, moment generating functions, and the central limit theorem. Prerequisites: MTH 2283 and MTH 2044.

**MTH 3383. Mathematics for Secondary Teachers.** This course develops problem-solving strategies and proofs in a variety of mathematical contexts, emphasizing the connections between algebra and geometry. The historical development of mathematics and how it affects mathematics today will be explored. **Prerequisites:** MTH 1243 or MTH 1253 or MTH 1274, MTH 2283.

**MTH 3553. Mathematics of Calculus and Technology for the Middle Grades.** An intuitive understanding of limits, derivatives with applications, and integration with applications will be developed using the mathematical practices and supported by appropriate technology and varied representational tools, including concrete models as appropriate for middle-level mathematics teachers. Prerequisite: grade of C or better in MTH 2483 and in one of the following: MTH 1213, MTH 1243, MTH1244, MTH 1273.

**MTH 3573. Transition to Advanced Mathematics.** A rigorous study of fundamental concepts of higher order mathematics, including set theory, logic, equivalence relations, and functions. Written and oral communications of mathematics with precision and rigor will be emphasized, particularly writing proofs. Prerequisites: MTH 1294, MTH 2283.

**MTH 3633. Advanced Mathematics for Middle Grades.** A course designed to meet the needs of students preparing for middle school licensure. At the completion of this course, students should be able to demonstrate their understanding of the basic concepts of advanced mathematics by representing, describing, interpreting, modeling, and generalizing mathematical phenomena. Technology and tools will be used strategically. Prerequisites: grade of C or better in MTH 2483 and in one of the following: MTH 1213, MTH 1243, MTH1244, MTH1273.

**MTH 3663. Applied Linear Algebra.** Topics may include systems of linear equations, vector spaces, linear transformations, matrix decompositions, orthogonality, determinants, eigenvalue problems, and diagonalization. Emphasis will be on concepts, calculations, applications, and appropriate software. Only one of MATH 3113 and MATH 3663 may be applied to a mathematics, computer science, or statistics degree, track, minor, or certificate. Prerequisite: MTH 1294.

**MTH 4093, 5093. Systems of Geometry II.** Continuation of MTH 3023. Includes non-Euclidean geometries. Prerequisite: MTH 3023.

**MTH 4133, 5133. (WI) Algebraic Structures I.** An introduction to the fundamental algebraic structures: groups, rings, and fields. Emphasis is placed on developing mathematical sophistication and rigor of proof. Prerequisite: MTH 2283, MTH 1294 and MTH 3573.

**MTH 4143, 5143. Algebraic Structures II.** Continuation of MTH 4133; advanced group theory and Galois theory. Prerequisite: MTH 4133.

**MTH 4153, 5153. History of Mathematics.** This course is an overview of the development of elementary mathematics from primitive counting to modern accomplishments in algebra, geometry, and calculus. Prerequisite: MTH 2044.

**MTH 4223, 5223. Introduction to Topology.** An introduction to topological spaces, homeomorphism, compactness, separations, and connectedness. Prerequisite: MTH 4133.

**MTH 4233, 5233. Advanced Calculus I.** A rigorous development of calculus of one and more variables. Topics include sequences, series, continuous and differentiable functions, integration theory, and series of functions. Prerequisites: MTH 2044, 4133.

**MTH 4303, 5303. Advanced Calculus II.** Continuation of MTH 4233. Prerequisite: MTH 4233.

**MTH 4331-3, 5331-3. Independent Study.** Independent study in an area of mathematics selected by the student and faculty advisor. Credit will vary from one (1) to three (3) hours. May be repeated. Prerequisite: consent of faculty advisor.

**MTH 4373, 5373. Numerical Analysis.** An introduction to numerical methods of problem solving to include error analysis, approximate solutions to equations of one variable, interpolation and polynomial approximation, numerical differentiation and integration, numerical solutions of differential equations, linear systems, and approximation of functions. Prerequisites: MTH 2044 and CSC 1104.

**MTH 4433, 5433. Probability and Statistics II.** The mathematical theory of probability and application of this theory to statistical inference. Topics include multivariable distributions, confidence intervals, tests of statistical hypotheses, linear models, 1-way analysis of variance, and quality control through statistical methods. Prerequisite: MTH 3163.

**MTH 4473, 5473. Simulation Theory.** See CSC 4213.

**MTH 4491-3, 5491-3. Special Topics in Mathematics Education.** A broad range of topics in mathematics content that will include, but not be limited to, algebra, geometry, probability, statistics, and data representation, and the use of technology. Topics will be addressed to middle school and/or high school teachers. Students will be able to repeat the course for credit when different topics are being presented than when the student previously took the class. A designation of the topics covered will be recorded on the transcript. Prerequisites: Secondary - MTH 1243, MTH 1294, or consent of the instructor. Middle School - MTH 1053, MTH 2483 or departmental consent.

**MTH 4563. Math Modeling and Applications for the Middle Grades.** This course will serve as the capstone course for students pursuing licensure in Middle School Mathematics and Science. Connections between other mathematics courses in the program will be broadened and explored using appropriate materials through laboratory experiences. The use of technology, including the Internet as an instructional source, as is appropriate for the middle grades will be incorporated to enhance problem-solving, communication and reasoning skills. Prerequisite: MTH 2553 or MTH 3633 or departmental consent.

**MTH 4621-6. Internship in Mathematics.** The professional internship is intended to provide a learning opportunity for students to 1) apply knowledge and skills acquired in the classroom in a professional context; 2) understand which skills are transferable to new contexts; 3) identify and understand the practices and protocols of the industry in which they are working; and 4) refine and reassess their own career goals as a result of the experience. Current employment may not be used for credit in this course. This is a credit/no credit course and may be repeated for a maximum of 6 credit hours. Prerequisite: Consent of Department.

**MTH 4673, MTH 5673. Complex Analysis.** This course will introduce functions of a complex variable. Topics will include complex numbers, polar form and topology of complex numbers, complex functions and mappings, limits and continuity, analytic and harmonic functions, elementary functions, complex integration, the Cauchy-Goursat Theorem, the Cauchy Integral Formula and its consequences, sequences and series of complex numbers, Taylor and Laurent series, classification of isolated singularities, residue theory and its applications, and conformal mappings and their applications. Course Prerequisites: MTH 3104 or consent of the department

**MTH 4893. (WI) Special Methods/Math.** This course emphasizes the strategies of teaching mathematics, the planning for teaching mathematics, and mathematical assessment programs. Topics include developing objectives, creating lessons, building units, designing an assessment plan, and appropriate use of manipulatives and technology. Prerequisite: MTH 3383 or departmental consent.

**MTH 4901. Senior Project. (WI)** Completion of a research paper on a topic consistent with student's degree track. Each student will work with a primary faculty mentor as well as a second reader; the paper will follow established departmental guidelines. This project will be completed during one of the last two semesters before graduation. Students will be required to present their papers in a departmental colloquium. Students will take the Major Field Test (Mathematics) as part of the grade for this course. Prerequisites: Senior Standing and departmental approval.

**MTH 4961-3, 5961-3. Special Topics in Mathematics.** Topics selected from the areas of analysis, algebra, geometry, topology, logic, statistics, or other areas according to student needs and the instructor's specialization. The student's transcript will indicate the specific topic covered. Because course content will vary, students may repeat the course for a maximum of six hours credit. Prerequisite: Departmental consent.

### **Courses in Statistics**

**STA 0312. Statistical Reasoning Review.** Students must be enrolled in STA1313 (Statistical Reasoning) to enroll in STA 0312. Students will learn and review basic statistical concepts as well as calculator skills that are needed to succeed in Statistical Reasoning. This course is required for students whose ACT mathematics score is below 19 who are enrolled in STA 1313, but is open to any student enrolled in STA1313.

**STA 1313. Statistical Reasoning.** Topics include basic descriptive statistics, correlation, regression, probability, sampling, experimental design, and distributions with an emphasis on analysis instead of computation. Prerequisite. A mathematics ACT score of at least 19 OR concurrent enrollment in STA 0312 OR a C or better in MTH0003.

**STA 1314. Statistical Reasoning - Enhanced.** Topics include basic descriptive statistics, correlation, regression, probability, sampling, experimental design, and distributions with an emphasis on analysis instead of computation. Meets three hours plus an additional two-hour laboratory per week. Prerequisites: MTH 0003 with a grade of C or better, or MTH ACT of 17 or better.

**STA 2054. Applied Biostatistics.** Topics include descriptive statistics, experimental design, correlation, regression, probability distributions, parametric and nonparametric procedures, tests of normality, ANOVA and ad hoc procedures. Applications in the biological sciences will be emphasized, and professional statistical software will be used. Course Prerequisites: MTH 1243 or MTH 1244 or MTH 1274 or STA 1313 or STA 1314, or consent of department.

**STA 2611, 2612, 2613, 2614, 2615, 2616. Internship in Statistics.** See MTH 4621.

**STA 2323. Statistical Methods.** Topics include descriptive statistics, correlation, regression, introduction to probability, basic probability distributions, confidence intervals, hypothesis testing, 1-way analysis of variance. Prerequisites: Prerequisites: MTH 1033 or MTH 1034 or MTH 1083 or MTH 1213 or MTH 1243 or MTH 1244, MTH 1274 or STA 1313 or STA 1314, or consent of department.

**STA 3163. Probability and Statistics I.** See MTH 3163.

**STA 3443. Statistical Computing.** An introduction to professional statistical software that involves data management, basic programming skills required for doing advanced applied statistics. Emphasis will be on data manipulation, statistical analysis, model fitting, simulation, parametric and nonparametric methods, communication, and interpreting results. (STA 2323 or STA 2054) and (MTH 1243 or MTH1244 or 1273).

**STA 4013. Applied Regression Analysis.** Simple linear regression and associated special topics, multiple linear regression, indicator variables, influence diagnostics, assumption analysis, selection of "best subset", nonstandard regression models, logistic regression, nonlinear regression models. Prerequisite: (STA 2323 or STA 2054) and (STA 3443 or MTH 1294)

**STA 4023. Applied Analysis of Variance.** One-way ANOVA, two-way additive ANOVA, two-way ANOVA with interaction, analysis of covariance, Levene's Test for homogeneity, ad hoc procedures, Kruskal Wallis Test, Randomized F test, and an introduction to experimental design. Prerequisite: (STA 2323 or STA 2054) and (STA 3443 or MTH 1294)

**STA 4033. Nonparametric Statistical Methods.** An introduction to distribution-free procedures which include the sign test, Wilcoxon tests, chi-squared tests, McNemar's test, bootstrapping, and rank-based ANOVA. The efficiency of these is compared with the corresponding classical procedures. Prerequisite: (STA 2323 or STA 2054) and (STA 3443 or MTH 1294)

**STA 4043. Statistical Analysis of Time Series.** Time series components, descriptive smoothing methods, regression models for time series data, forecasting via exponential smoothing, evaluation of forecasts, autocorrelation, ARIMA models and Box-Jenkins methods, combining forecasts, frequency domain analysis, filtering. (STA 2323 or STA 2054) and (STA 3443 or MTH 1294)

**STA 4171-3. Special Topics in Statistics.** Topics selected from statistics and data science designed to meet student needs and the instructor's specialization. The student's transcript will indicate the specific topic covered. Because course content will vary, students may repeat the course for a maximum of six hours credit. Prerequisite: Departmental consent.

**STA 4433. Probability and Statistics II.** See MTH 4433.

**STA 4621, 4622, 4623, 4624, 4625, 4626. Internship in Statistics.** See MTH 4621.

## Courses in Computer Science

**CSC 1104. Foundations of Computer Science I.** A study of programming, concepts and techniques. Topics included are: binary representation of numbers and characters, data types of constants and variables, arithmetic expressions and the hierarchy of arithmetic operations, assignment statements, logical expressions, branching, loops, arrays, sub-programs, input/output, linear and binary searches, and basic sorts. Programming style is introduced through pseudocode. Meets for three-hours lecture and two-hours laboratory each week. Prerequisite: MTH 0013 – Intermediate Algebra, with a grade of C or better; or required math test score. An ACT math score of 21 or above is recommended.

**CSC 1114. Foundations of Computer Science II.** A continuation of Foundations of Computer Science I. Good programming style is stressed. Topics included are: documentation of programs, step-wise refinement, structuring programs, top-down design of programs, internal sorts, and linear data structures. Meets for three hours lecture and two-hours laboratory each week. Prerequisite: CSC 1104 – Foundations of Computer Science I.

**CSC 2003 (CPSI1003). Introduction to Computers.** A computer literacy course introducing the novice to the use of the computer. Topics included are: problems having practical computer solutions, available software, computer terminology. Examples from business, education, political science and the social sciences are included. This does not count toward a computer science major or minor.

**CSC 2013. Windows Security Fundamentals.** This course looks at the strategies and techniques an individual can use to protect a Windows based system from external attack. Topics include: access controls, encryption, malware, group policy, backup and recovery, network security, and application security.

**CSC 2163. Computer Applications.** A theoretical and practical study of current computer application software. Applications covered will vary by semester. May be repeated with change in content. This does not count toward a computer science major or minor.

**CSC 2173. Assembler Language.** A study of the basic concepts of computer systems and an introduction to an assembler language. Topics included are: computer structure and machine language, assembler language, addressing techniques, macros, and I/O routines. Prerequisite: CSC 1104 – Foundations of Computer Science I.

**CSC 2203. Data Structures.** The objective of this course is to apply analysis and design techniques to nonnumeric algorithms that act on data structures. Topics will include linked lists, queues, stacks, trees, AVL trees, and string handling algorithms. Prerequisite: CSC 1114 – Foundations of Computer Science II.

**CSC 2611/6. Internship in Computer Science.** The professional internship is intended to provide a learning opportunity for beginning students to: 1) apply knowledge and skills acquired in the classroom in a professional context; 2) understand which skills are transferable to new contexts; 3) identify and understand the practices and protocols of the industry in which they are working; and 4) refine and reassess their own career goals as a result of the experience. Current employment may not be used for credit in this course. This is a credit/no credit course and may be repeated for a maximum of 6 credit hours. Prerequisite: Consent of Department.

**CSC 3133. Introduction to Database Theory.** An introduction to database management systems. Topics covered include: structures, indexing, E-R model, relational model, relational algebra and calculus, query languages, SQL, constraints and normalizations, transaction management, integrity and security issues. Prerequisite: CSC 2203 – Data Structures.

**CSC 3144. Digital Electronics.** Topics covered include binary and hex arithmetic, boolean algebra, logic gates, transistors and diodes, logic families, flip-flops, counters, power supplies, comparators, A-D, D-A converters, digital instruments. Meets for three lecture periods and a two-hour laboratory period each week. Prerequisite: PHY 2234 – University Physics I and PHY 2244 – University Physics II.

**CSC 3153. Introduction to Compiler Theory.** An introduction to the formal study of languages and compiler construction: Topics included are: programming language basics, finite automata and lexical analysis, grammars, top-down and bottom-up parsers, syntax-directed translation, code generation, and code optimization. Prerequisite: CSC 2173 – Assembler Language and CSC 3433 – Computational Complexity.

**CSC 3193. Operating Systems.** A study of the principles of operating systems and the interrelationships between operating systems and computer architecture. Topics included are: system structure, memory management, process management, and recovery procedures. Prerequisite: CSC 3443 – Computer Organization.

**CSC 3223. Algorithm Analysis.** An introduction to the analysis and design of algorithms, and to techniques for measuring their complexity. Prerequisites: CSC 2203 – Data Structures and MTH 1295 – Calculus I or consent of Department.

**CSC 3433. Computational Complexity.** A study of basic theoretical computer science concepts. Topics will include formal language theory and results, non-determinism, grammars, Turing machines, halting problem, and decidability among others. Prerequisite: CSC 3223 – Algorithm Analysis.

**CSC 3443. Computer Organization.** An introductory course in computer organization and architecture. Topics included are: machine level representation of data, memory system organization and architecture, I/O fundamentals, buses, pipelining, multiprocessing, and system performance enhancements. Prerequisite: CSC 2173 – Assembler Language.

**CSC 3453. Programming Languages.** Comparison of the organization and structure of procedural, object-oriented, functional, declarative, and scripting languages. Additional topics will include language translation, abstraction mechanisms, language design and semantics. Prerequisite: CSC 2203 – Data Structures.

**CSC 3463. Software Engineering.** A study of the methods used in the design, development, implementation, testing and maintenance of software systems. Students will utilize the team approach in the development and management of software projects and will make use of modern tools to achieve these tasks. Prerequisite: CSC 3223 – Algorithm Analysis.

**CSC 3472. (WI) Technology and Society.** A course that allows the student to explore and develop an understanding of the social and professional context in which computing is done. Topics included are: computing history, professional responsibilities, risks and liabilities, intellectual property, privacy, computer crime, and economic issues. Prerequisite: CSC 3463 – Software Engineering.

**CSC 4184. Interfacing and Machine Control.** A study of hardware interfacing components and techniques. Topics covered include: embedded controllers, communication controllers, PCBs, embedded logic, debugging strategies, interrupts, multitasking, and networking. Prerequisite: CSC 3443 – Computer Organization.

**CSC 4213. Simulation Theory.** A study of the fundamental principles involved in the construction of computer simulation models. Topics included are: random number generators, model construction, queuing models, and inventory models. Prerequisite: STA 2323 – Statistical Methods or MTH 3163 – Probability and Statistics I, and CSC 1114 – Foundations of Computer Science II or consent of department.

**CSC 4263. Client/Server Programming.** A study of the principles governing client/server programming. Topics included are: client/server model, concurrency, protocols and interfaces, issues in software design, connectionless vs. connection-oriented servers, iterative vs. concurrent servers, RPCs, and selected case studies. Prerequisite: CSC 2203 – Data Structures.

**CSC 4273. Introduction to Data Communication.** A study of the fundamental principles involved in data communication and a general overview of various data communication systems. Topics included are baud rates, modem controls, protocols, error detection and correction, communication line characteristics, synchronous and asynchronous communication, application interface software, network systems, analysis of communication systems. Prerequisite: CSC 3443 – Computer Organization.

**CSC 4283. Introduction to Networking.** A study of Local Area Network Standards and an implementation of a LAN. Topics covered include: LAN topologies, transmission media, access methods, OSI layer implementations, NOS installation, management, print servers, and network management software. Prerequisites: CSC 3443 – Computer Organization or consent of Department.

**CSC 4293. Numerical Analysis.** An introduction to numerical methods of problem solving to include error analysis, interpolation procedures, differentiation, integration, solutions of non-linear and differential equations, and approximation of functions. Prerequisites: MTH 2045 – Calculus II and CSC 1104 – Foundations of Computer Science I.

**CSC 4331-3. Independent Study.** Independent study in an area of computer science selected by the student and faculty advisor. Credit will vary from one to three hours. May be repeated. Prerequisite: consent of Department.

**CSC 4421-3. Special Topics in Computer Science.** Variable content course covering current and advanced topics in computer science. May be repeated with change in content. Prerequisite: consent of Department.

**CSC 4483. Computer Science Capstone.** A project course requiring the computer science student to develop and implement a capstone project requiring the integration of software, hardware components, and human factors. Software engineering methodologies along with good written and verbal communications skills will be required. Program assessment tools will be administered. Prerequisites: CSC 3463 – Software Engineering, CSC 3113 – Database Theory, and CSC 3193 – Operating Systems.

**CSC 4493. Artificial Intelligence.** An introduction to machine intelligence. Topics covered include: AI languages, problem solving strategies, searching, knowledge representations, natural language processing, machine learning, expert systems, neural networks, and robotics. Prerequisite: CSC 3223 – Algorithm Analysis.

**CSC 4503. Computer Graphics.** A course that provides an introduction to basic 3D computer graphics programming techniques. Topics included are: OpenGL library, user interface design, projection and transformations, basic animation, etc. Prerequisite: CSC 3223 – Algorithm Analysis.

**CSC 4513. Visual Programming.** An introduction to visual programming. Topics covered include: interface design, object oriented concepts, Internet programming, data reporting, error handling, help file creation, linkages, etc. Prerequisite: CSC 3223 – Algorithm Analysis.

**CSC 4621/6. Internship in Computer Science.** The professional internship is intended to provide a learning opportunity for advanced students to: 1) apply knowledge and skills acquired in the classroom in a professional context; 2) understand which skills are transferable to new contexts; 3) identify and understand the practices and protocols of the industry in which they are working; and 4) refine and reassess their own career goals as a result of the experience. Current employment may not be used for credit in this course. This is a credit/no credit course and may be repeated for a maximum of 6 credit hours. Prerequisite: Consent of Department.