

Department of Mathematics and Computer Sciences

MAJORS

[Applied Mathematics \(BS\)](#)

[Mathematics for Secondary Education \(BS\)](#)

[Bioinformatics \(BS\)](#)

[Computer Science \(BS\)](#)

[Cybersecurity \(BS\)](#)

[Management Information Systems \(BS\)](#)

[General Studies -- Applied Mathematics \(BA\); Computer Science \(BA\);
Management Information Systems \(BA\)](#)

MINORS

[Applied Mathematics](#)

[Bioinformatics](#)

[Computer Science](#)

[Cybersecurity](#)

[Data Analytics](#)

[Management Information Systems](#)

CERTIFICATES

[Cybersecurity](#)

[Website Development](#)

CONCENTRATIONS

[Cybersecurity](#)

[Mathematics for Middle School](#)

DEGREE PROGRAM AFFILIATIONS

[Dual Degree Program in Engineering with the University of Missouri–Kansas City
and with Washington University in St. Louis](#)

The department of mathematics and computer science offers the bachelor of science degree with majors in applied mathematics, mathematics for secondary

education, bioinformatics, computer science, cybersecurity, and management information systems. The degree in applied mathematics can be readily combined

with a dual degree in engineering from the University of Missouri - Kansas City or Washington University in St. Louis.

Students may also choose minors in applied mathematics, computer science, cybersecurity, data analytics and management information systems. Students pursuing a major in applied mathematics, computer science or management information systems may also choose a concentration in cybersecurity. The department of mathematics and computer science, together with the department of fine arts, also offers a certificate in website development and design. The department also offers a concentration and a certificate in cybersecurity.

Graduate students may earn a master of science degree in computer science, or instructional design and technology. See the graduate programs section of this catalog.

The rigorous curriculum in each program emphasizes thinking analytically, solving problems, and communicating effectively. Specifically, through its programs, the department seeks to

- acquaint students with current developments in bioinformatics, computer science, cybersecurity, management information systems, applied mathematics, mathematics education, and instructional design and technology;
- equip graduates with essential knowledge and skills to secure professional positions in their fields; and
- prepare students for successful transitions from the classroom to the workplace.

To achieve these objectives, the department encourages students to interact with faculty by providing individual advising and creating an environment that is conducive to continued professional growth. With the assistance of the department, students may pursue their professional goals through internships and research.

If a student intending to major in the department is not ready for placement into MTH 150 (Calculus with Analytic Geometry I) upon matriculation, the student must meet the following minimum grade requirements in the prerequisite courses:

- If placed into MTH 091, the student must earn a grade of at least A- to progress to MTH 095.
- If placed into MTH 095, the student must earn a grade of at least A- to progress to MTH 105 and/or CIS 160.
- If placed into MTH 105, the student must earn a grade of at least B- to progress to MTH 150.
- If placed into MTH 110, the student must earn a grade of at least B- to progress to MTH 150.

A student pursuing a major in the department must earn a grade of B- or better in CIS 160 to progress to CIS 161, and in CIS 161 to progress to CIS 210 and above.

FACULTY

Mary Abkemeier, professor of mathematics and computer science and chairperson of the department of mathematics and computer science; director of the master of science in computer science

Zahid Anwar, assistant professor of mathematics and computer science

Nancy English, associate professor emeritus of mathematics and computer science

Kathryn Graves, assistant professor of mathematics and computer science; liaison for the dual degree engineering programs

M. Elizabeth Newton, professor of mathematics and computer science

Bahareh Rahmani, assistant professor of mathematics and computer science

Kathleen Roy, assistant professor of mathematics and computer science

Guanyu Tian, assistant professor of mathematics and computer science

Samantha Warren, assistant professor of mathematics and computer science

Adam Weyhaupt, dean, College of Arts & Sciences, associate professor of mathematics and computer science

Yi Yang, assistant professor of mathematics and computer science

UNDERGRADUATE PROGRAMS

Major Approval

Major approval is required during the second semester of the sophomore year, or after the completion of 45 credit hours at Fontbonne. For transfer students, major approval is required after completing the equivalent of one full semester (*a minimum of 12 credits*) at Fontbonne.

Students are required to earn a minimum cumulative grade point average of 2.5 in the courses specified below along with the submission of their Portfolio A to continue in their major program at the time of application for major approval.

Applied Mathematics and Mathematics for Secondary Education Majors:

MTH 115, MTH 120, MTH 150

Bioinformatics Majors:

MTH 125, CIS 161, BNF 200

Computer Science

CIS 160, CIS 161, MTH 150

Cybersecurity Majors:
CIS 125, CIS 160, CIS 161

Management Information Science Major:
CIS 120, CIS 160, CIS 161

For transfer students, who did not take these courses at Fontbonne University, 12 credit hours of appropriate coursework will be stipulated by the faculty of the department. The department reserves the right to administer a test in the appropriate discipline for acceptance into its major programs when deemed necessary.

Majors in the Department of Mathematics and Computer Science (with the exception of Mathematics for Secondary Education majors – see Major in Mathematics for Secondary Education section of this catalog) must have an overall GPA of 2.0 as well as a 2.0 GPA in the major required coursework in order to earn a BS Degree. To earn a minor from this department, students must obtain a minimum GPA of 2.0 in the minor required coursework.

MAJOR IN APPLIED MATHEMATICS

This major exposes students to various areas of applied mathematics, including mathematical modeling and statistics. Computer programming and software applications are also included in this major. Internships are available as MTH 284 and 484, but are not required.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section in this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Courses Required for the Major

MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 151 Calculus with Analytic Geometry II (4 credits)
MTH 200 Linear Algebra (3 credits)
MTH 250 Calculus with Analytic Geometry III (4 credits)
MTH 310 Differential Equations (3 credits)
MTH 430 Algebraic Structures (3 credits)
MTH 498 Senior Portfolio (1 credit)
MTH 499 Senior Synthesis (3 credits)

One of the following two courses (3 credits):
MTH 115 Introduction to Statistics
MTH 125 Biostatistics

Three of the following five courses (9 credits):
MTH 300 Modeling and Numerical Approximation
MTH 315 Advanced Statistics
MTH 316 Non-Parametric Statistics
MTH 325 Theory and Applications of Probability
MTH 385 Principles of Cryptography

Courses Required in Other Disciplines

An application area may be selected from any of the following: accounting, business, biology, chemistry, computer science, cybersecurity, education, finance, food management, general science, psychology, or web development and design. Details for each application area follow.

Accounting Application Area (25 credits)

ACT 210 Financial Accounting (3 credits)
ACT 220 Managerial Accounting (3 credits)
ACT 310 Intermediate Accounting I (3 credits)
ACT 320 Intermediate Accounting II (3 credits)
ACT 420 Accounting Information Systems (3 credits)
CIS 110 Computer Applications: Spreadsheets (3 credits)
CIS 160 Computer Science I (4 credits)
ACT 350 Income Taxation for Individuals **OR**
ACT 430 Advanced Financial Management (3 credits)

Biology Application Area (25-26 credits)

BIO 112 General Biology I with Lab (4 credits)
BIO 114 General Biology II with Lab (4 credits)
BIO 212 Genetics (3 credits)
BIO 318 Cell and Molecular Biology (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
BNF 200 Scientific Computing Language (3 credits) **OR**
CIS 210 Object-Oriented Programming (4 credits)

Business Application Area (25 credits)

ECN 210 Principles of Macro Economics (3 credits)
ECN 220 Principles of Micro Economics (3 credits)
ACT 210 Financial Accounting (3 credits)
ACT 220 Managerial Accounting (3 credits)

FIN 310 Managerial Finance (3 credits)
CIS 110 Computer Applications: Spreadsheets (3 credits)
CIS 111 Computer Applications: Database (3 credits)
CIS 160 Computer Science I (4 credits)

Chemistry Application Area (33 credits)

The chemistry application area contains the requirements for the chemistry minor as it is defined in the department of biological and physical sciences section of this catalog.

CHM 106 General Chemistry I with Lab (4 credits)
CHM 108 General Chemistry II with Lab (4 credits)
CHM 210 Organic Chemistry I (3 credits)
CHM 211 Organic Chemistry I lab (2 credits)
CHM 212 Organic Chemistry II (3 credits)
CHM 213 Organic Chemistry II lab (2 credits)
CHM 318 Biochemistry (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)

Computer Science Application Area (25 credits)

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)
CIS 250 Algorithms and Data Structures (4 credits)
Plus three courses chosen from among the 300 and 400-level CIS courses. (9 credits)

CyberSecurity Application Area (24 credits)

CIS 125 Introduction to Cybersecurity, Cyber Crime and Policies (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)

Plus nine credits from the list of courses below:

CIS 355 Operating Systems **AND** CIS 356 Operating System Security and Maintenance
CIS 340 Concepts of Telecommunications and Networking **AND** CIS 345 Network Security and Management
CIS 380 Web Development Security **AND** CIS 415 Server Security
CIS 215 Database Fundamentals and Web Server Programming
CIS 385 Principles of Cryptography
CIS 390 Personal Computer Security and Maintenance
CIS 392 Ethical Hacking
CIS 410 Wireless Communication and Mobile Forensics
CIS 425 Digital Forensics and Analysis

Data Analytics Application Area (29 credits)

BNF 200 Scientific Computing Languages (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 330 Database Management Systems (3 credits)
MTH 315 Advanced Statistics (3 credits)

MTH 325 Theory and Applications of Probability (3 credits)
MTH 335 Survey of Data Analysis and Visualization (3 credits)
MTH 455 Machine Learning I (3 credits)
MTH 470 Machine Learning II (3 credits)

Education Application Area (29 credits)

EDU 268 Introduction to Learner Development (3 credits)
EDU 269 Critical Skills in the Teaching Profession with Field Experience (3 credits)
EDU 270 Introduction to Learner Diversity (3 credits)
EDU 350 Methods of Teaching Reading in the Content Areas (3 credits)
EDU 401 Classroom/Behavior Management Middle/Secondary (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)

Two of the following three courses (6 credits)

EDU 271 Introduction to Content, Planning, Delivery and Assessment
EDU 392 Assessment of Ability and Achievement
EDU 447 Planning for Instruction & Assessment-Middle & Secondary

Finance Application Area (28 credits)

ECN 210 Principles of Macro Economics (3 credits)
ECN 220 Principles of Micro Economics (3 credits)
ACT 210 Financial Accounting (3 credits)
FIN 310 Managerial Finance (3 credits)
FIN 320 Money and Banking (3 credits)
CIS 110 Computer Applications: Spreadsheets (3 credits)
CIS 160 Computer Science I (4 credits)

Two of the following four courses (6 credits):

FIN 325 Credit Management
FIN 330 Investments
FIN 335 Commercial Banking
ACT 410 Auditing

General Science Application Area (27-28 credits)

CHM 106 General Chemistry I with Lab (4 credits)
PHY 218 Engineering Physics I with Lab (calculus-based) (4 credits)
PHY 220 Engineering Physics II with Lab (calculus-based) (4 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)

One of the following 4 courses (3-4 credits):

BIO 108 Introduction to Life Science w/Lab
BIO 112 General Biology I w/Lab
BIO 203 Science & Society
CHM 108 General Chemistry II with Lab

Psychology Application Area (26 credits)

PSY 100 Introduction to Psychology (3 credits)
PSY 327 Industrial/Organizational Psychology (3 credits)
PSY 330 Research Methods for Behavioral Sciences
(3 credits)
PSY 335 Cognitive Psychology (3 credits)
PSY 391 Testing and Measurement for Behavioral
Sciences (3 credits)
BNF 200 Scientific Computer Programming (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)

Web Development and Design Application Area (23 credits)

ART 115 Introduction to Graphic Design (3 credits)
ART 202 Introduction to Web Design (3 credits)
ART 302 Web Design II (Advanced) (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 215 Database Fundamentals and Web Server
Programming (3 credits)
CIS 315 Advanced SSP (3 credits)

**SEE THE END OF THE SECTION ON MAJORS
FOR THE COURSE REQUIREMENTS FOR
MINORS, CERTIFICATES AND
CONCENTRATIONS.**

MAJOR IN MATHEMATICS FOR SECONDARY EDUCATION

This program offers a curriculum designed specifically to meet the needs of the future secondary mathematics teacher. The curriculum for this major combines theory and applications of mathematics, principles and methods of secondary education, experience with mathematical software and computer programming, and field experience. Mathematics majors seeking teaching certification must have a cumulative GPA of 2.75 in college coursework, a 3.0 GPA in professional education courses, and a 3.0 GPA in mathematics content courses.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section of this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

Teacher Certification Requirements

Full information on teacher certification may be found in the section titled Teacher Certification at Fontbonne University following the graduate programs' section in this

catalog, as well as in the appropriate departmental sections of this catalog.

General Education Requirements

The 42 credit hours of general education requirements are explained in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Courses Required for the Major

MTH 115 Introduction to Statistics (3 credits)
MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 151 Calculus with Analytic Geometry II (4 credits)
MTH 200 Linear Algebra (3 credits)
MTH 250 Calculus with Analytic Geometry III (4 credits)
MTH 305 Readings in the History of Mathematics
(2 credits)
MTH 320 Elements of Geometry (3 credits)
MTH 430 Algebraic Structures (3 credits)
MTH 498 Senior Portfolio (1 credit)
MTH 499 Senior Synthesis (3 credits)

Two of the following four courses (6 credits):
MTH 300 Modeling and Numerical Approximation
MTH 315 Advanced Statistics
MTH 325 Theory and Applications of Probability
CIS 465 Robotics

Courses Required in Other Disciplines

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
PSY 200 Developmental Psychology (3 credits)

One of the following two courses (3-4 credits):
BIO 112 General Biology I with Lab
BIO 108 Introduction to Life Science

One of the following two pairs of courses (8 credits):
PHY 218 Engineering Physics I with Lab **AND** PHY 220
Engineering Physics II with Lab
CHM 106 General Chemistry I with Lab **AND** CHM 108
General Chemistry II with Lab

Professional Courses Required For Certification

EDU 268 Introduction to Learner Development (3 credits)
EDU 269 Critical Skills in the Teaching Profession with
Field Experience (3 credits)
EDU 270 Introduction to Learner Diversity (3 credits)
EDU 271 Introduction to Content Planning, Delivery
and Assessment(3 credits)
EDU 306 Analysis and Correction of Reading Difficulties
(3 credits)

EDU 313 Methods & Practicum for Middle, Secondary, & Community Education (3 credits)
EDU 350 Methods of Teaching Reading in the Content Area (3 credits)
EDU 401 Classroom/Behavior Management Techniques – Middle/Secondary) (3 credits)
EDU 447 Planning for Instruction and Assessment Middle and Secondary (3 credits)
EDU 451 Student Teaching at the Secondary Level (12-16 credits)

SEE THE END OF THE SECTION ON MAJORS FOR THE COURSE REQUIREMENTS FOR MINORS, CERTIFICATES AND CONCENTRATIONS.

MAJOR IN BIOINFORMATICS

This major includes courses in computer science, mathematics and biology and prepares students for a career in the field of bioinformatics. Specialists in bioinformatics use computational analyses to study the vast information provided by modern molecular biology, such as DNA and protein sequence analyses, fields which are growing at an unprecedented rate.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section of this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Required Courses in Bioinformatics

BNF 200 Scientific Computing Languages (3 credits)
BNF 210 Sequence, Evolution and Structure (3 credits)
BNF 301 Computational Genomics (3 credits)
BNF 498 Senior Portfolio (1 Credit)
BNF 499 Senior Synthesis (3 credits)

Required Courses in Other Disciplines

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (Java) (4 credits)
CIS 250 Algorithms and Data Structures (4 credits)
CIS 330 Database Management Systems (3 credits)
MTH 120 Discrete Mathematics (3 credits)

MTH 125 Biostatistics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 325 Theory and Applications of Probability (3 credits)
BIO 112 General Biology I with lab (4 credits)
BIO 114 General Biology II with lab (4 credits)
BIO 204 Modeling and Experimental Design (3 credits)
BIO 212 Genetics (3 credits)
BIO 318 Cell and Molecular Biology (3 credits)

Four of the following courses (12 credits):

CIS 335 Survey of Data Analytics and Visualization
CIS 355 Principles of Operating Systems
CIS 375 Software Engineering I
CIS 421 Compiling Theory & Programming Languages
CIS 455 Machine Learning I
CIS 465 Robotics
CIS 470 Machine Learning II
CIS 472 Android Programming **OR** CIS 473 iOS Programming
CIS 475 Software Engineering II
BNF 480 Research in Bioinformatics **OR** BNF 484 Internship in Bioinformatics

Two of the following courses (6-8 credits):

MTH 151 Calculus with Analytic Geometry II
MTH 200 Linear Algebra
MTH 250 Calculus with Analytic Geometry III
MTH 300 Modeling and Numerical Approximation
MTH 315 Advanced Statistics
MTH 316 Non-Parametric Statistics
MTH 430 Algebraic Structures

SEE THE END OF THE SECTION ON MAJORS FOR THE COURSE REQUIREMENTS FOR MINORS, CERTIFICATES AND CONCENTRATIONS.

MAJOR IN COMPUTER SCIENCE

This major includes both theory and application and prepares students for a variety of challenging careers in the field of computer science.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section of this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Courses Required for the Major:

- CIS 120 Overview of Computer and Information Science (3 credits)
- CIS 160 Computer Science I (4 credits)
- CIS 161 Computer Science II (4 credits)
- CIS 210 Object-Oriented Programming (4 credits)
- CIS 250 Algorithms and Data Structures (4 credits)
- CIS 310 Computer Architecture and Assembly Language (3 credits)
- CIS 330 Database Management Systems (3 credits)
- CIS 340 Concepts of Telecommunications and Networking (3 credits)
- CIS 355 Principles of Operating Systems (3 credits)
- CIS 375 Software Engineering I (3 credits)
- CIS 421 Compiling Theory and Programming Languages (3 credits)
- CIS 498 Senior Portfolio (1 credit)
- CIS 499 Senior Synthesis (3 credits)

Two electives chosen from the following (6 credits):

- CIS 345 Network Security and Management
- CIS 356 Operating System Security and Administration
- CIS 465 Robotics
- CIS 394 Topics in Computer Science*
- CIS 460 Artificial Intelligence
- CIS 472 Android Programming or CIS 473 iOS Programming
- CIS 475 Software Engineering II
- CIS 480 Research in Computer Science*
- CIS 484 Internship in Computer Science*
- CIS 490 Independent Study in Computer Science*
- CIS 494 Advanced Topics in Computer Science*

*At most one of the two electives may be chosen from among these courses.

Courses Required in Other Disciplines:

- MTH 115 Introduction to Statistics (3 credits)
- MTH 120 Discrete Mathematics (3 credits)
- MTH 150 Calculus with Analytic Geometry I (4 credits)
- MTH 151 Calculus with Analytic Geometry II (4 credits)
- MTH 200 Linear Algebra (3 credits)
- MTH 300 Modeling and Numerical Approximation (3 cr)
- MTH 430 Algebraic Structures (3 credits)

Two of the following courses (7-8 credits):

- BIO 108 Introduction to Life Science with Lab
- BIO 112 General Biology I with Lab
- BIO 114 General Biology II with Lab
- CHM 106 General Chemistry I with Lab
- CHM 108 General Chemistry II with Lab
- PHY 208 College Physics with Lab
- PHY 210 College Physics II with Lab
- MTH 250 Calculus with Analytic Geometry III
- MTH 315 Advanced Statistics
- MTH 385 Cryptography

SEE THE END OF THE SECTION ON MAJORS FOR THE COURSE REQUIREMENTS FOR MINORS, CERTIFICATES AND CONCENTRATIONS.

MAJOR IN CYBERSECURITY

This major presents the theory, processes and practices of cybersecurity, designed to prepare students in careers that include the protection of networks, computers, programs and data from damage or unauthorized access.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section of this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Courses Required for the Major

- CIS 120 Overview of Computer and Information Science (3 credits)
- CIS 125 Introduction to Cybersecurity, Cyber Crime and Policies (3 credits)
- CIS 160 Computer Science I (4 credits)
- CIS 161 Computer Science II (4 credits)
- CIS 210 Object-Oriented Programming (4 credits)
- CIS 215 Database Fundamentals and Web Server Programming (3 credits)
- CIS 250 Algorithms and Data Structures (4 credits)
- CIS 330 Database Management Systems (3 credits)
- CIS 340 Concepts of Telecommunications and Networking (3 credits)
- CIS 345 Network Security and Management (3 credits)
- CIS 355 Principles of Operating Systems (3 credits)
- CIS 356 Operating System Security and Administration (3 credits)
- CIS 380 Web Development Security (3 credits)
- CIS 385 Cryptography (3 credits)
- CIS 392 Ethical Hacking (3 credits)
- CIS 415 Server Security and Maintenance/Troubleshooting (3 credits)
- CIS 425 Digital Forensics and Analysis (3 credits)
- CIS 498 Senior Portfolio (1 credit)
- CIS 499 Senior Synthesis (3 credits)

Two electives chosen from the following (6 credits):

- CIS 390 Personal Computer Security and Maintenance
- CIS 395 Topics in Cybersecurity*
- CIS 410 Wireless Communication and Mobile Forensics
- CIS 481 Research in Cybersecurity*
- CIS 485 Internship in Cybersecurity*
- CIS 491 Independent Study in Cybersecurity*
- CIS 495 Advanced Topics in Cybersecurity*

*At most one of the two electives may be chosen from among these courses.

Courses Required in Other Disciplines

- MTH 115 Introduction to Statistics (3 credits)
- MTH 120 Discrete Mathematics (3 credits)
- MTH 150 Calculus with Analytic Geometry I (4 credits)
- MTH 430 Algebraic Structures (3 credits)

Courses Recommended in Other Disciplines

- PHL 221 Business Ethics (3 credits)
- PSY 100 Introduction to Psychology (3 credits)
- PSY 310 Social Psychology (3 credits)

MAJOR IN MANAGEMENT INFORMATION SYSTEMS

This program emphasizes the relationship between computer science and business and prepares students for professional careers in areas such as systems analysis and design.

Baccalaureate Degree and Residency Requirements

All requirements for an undergraduate degree are listed under academic policies and regulations in the undergraduate introductory section of this catalog. These requirements include a graduation requirement of at least one course in religion or theology.

General Education Requirements

The 42 credit hours of general education requirements are presented in the undergraduate academic information section of this catalog. A course that meets a general education requirement may also meet a course requirement in the major or a course requirement in another discipline.

Courses Required for the Major

- CIS 120 Overview of Computer and Information Science (3 credits)
- CIS 160 Computer Science I (4 credits)
- CIS 161 Computer Science II (4 credits)
- CIS 210 Object-Oriented Programming (4 credits)
- CIS 330 Database Management Systems (3 credits)
- CIS 340 Concepts of Telecommunications and Networking (3 credits)
- CIS 355 Principles of Operating Systems (3 credits)
- CIS 375 Software Engineering I (3 credits)
- CIS 498 Senior Portfolio (1 credit)
- CIS 499 Senior Synthesis (3 credits)

Three electives chosen from the following (9 credits):

- CIS 300 Modeling and Numerical Approximation
- CIS 310 Computer Architecture and Assembly Language
- CIS 396 Topics in Management Information Systems*
- CIS 421 Compiling Theory and Programming Languages
- CIS 460 Artificial Intelligence
- CIS 465 Robotics
- CIS 472 Android Programming or CIS 473 iOS Programming
- CIS 475 Software Engineering II
- CIS 482 Research in Management Information Systems*
- CIS 486 Internship in Management Information Systems*
- CIS 492 Independent Study in Management Information Systems*
- CIS 496 Advanced Topics in Management Information Systems*

*At most one of the three courses may be chosen from among these courses.

Courses Required in Other Disciplines

ACT 210 Financial Accounting (3 credits)
ECN 210 Principles of Macro Economics (3 credits)
ECN 220 Principles of Micro Economics (3 credits)
MGT 210 Management Principles (3 credits)
MKT 210 Marketing Principles (3 credits)
FIN 310 Managerial Finance (3 credits)
MTH 115 Introduction to Statistics (3 credits)
MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)

MINORS

A student must successfully complete, at Fontbonne, a minimum of 50 percent of the credit hours required for the minor.

MINOR IN APPLIED MATHEMATICS (20 CREDITS)

This minor provides students in other majors with a solid practical background in major branches of modern mathematics.

Courses Required for the Minor:

MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 151 Calculus with Analytic Geometry II (4 credits)

One of the following two courses (3 credits):

MTH 115 Introduction to Statistics
MTH 125 Biostatistics

Two of the following six courses (6 credits):

MTH 300 Modeling and Numerical Approximation
MTH 315 Advanced Statistics
MTH 316 Non-Parametric Statistics
MTH 320 Elements of Geometry
MTH 325 Theory and Applications of Probability
MTH 430 Algebraic Structures

MINOR IN BIOINFORMATICS (25 CREDITS)

This minor provides a solid background in bioinformatics.

Courses required for the Minor:

BIO 112 General Biology I with Lab (4 credits)
BIO 114 General Biology II with Lab (4 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
BNF 200 Scientific Computing Languages (3 credits)
BNF 210 Sequence, Evaluation and Structure (3 credits)
BNF 301 Computational Genomics (3 credits)

MINOR IN COMPUTER SCIENCE (22 CREDITS)

This minor provides a solid background in computer science.

Courses Required for the Minor:

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)
CIS 250 Algorithms and Data Structures (4 credits)

Two of the following four courses (6 credits):

CIS 310 Computer Architecture and Assembly Language
CIS 340 Concepts of Telecommunications and Networking
CIS 355 Principles of Operating Systems
CIS 375 Software Engineering I

MINOR IN CYBERSECURITY (20 CREDITS)

This minor provides a solid background in cybersecurity.

Courses Required for the Minor:

CIS 125: Introduction to Cybersecurity, Cyber Crime, and Policies (3)
CIS 160: Computer Science I (4)
CIS 161: Computer Science II (4)

Three courses from the list below (9 credits):

CIS 355 Principles of Operating Systems **and** CIS 356 Operating System Security and Administration
CIS 340 Concepts of Telecommunications and Networking **and** CIS 345 Network Security and Management
CIS 380 Web Development Security **and** CIS 415 Server Security and Maintenance/Troubleshooting
CIS 215 Database Fundamentals and Web Server Programming
CIS 385 Principles of Cryptography
CIS 390 Personal Computer Security and Maintenance
CIS 392 Ethical Hacking
CIS 410 Wireless Communication and Mobile Forensics
CIS 425 Digital Forensics and Analysis

MINOR IN DATA ANALYTICS (32 CREDITS)

Data analytics applies fundamental scientific principles of the analysis of large, complex data sets. This minor will interest students with an aptitude in computer science, mathematics and especially statistics. This minor complements students studying computer science, bioinformatics, cybersecurity, and management information systems.

Courses Required for the Minor:

BNF 200 Scientific Computing Languages (3 credits)
CIS 161 Computer Science II (4 credits)
CIS 330 Database Management (3 credits)
MTH 151 Calculus and Analytic Geometry II (4 credits)
MTH 200 Linear Algebra (3 credits)
MTH 315 Advanced Statistics (3 credits)
MTH 325 Theory and Applications of Probability (3 credits)
MTH 335 Survey of Data Analysis and Visualization (3 credits)
MTH 455 Machine Learning I (3 credits)
MTH 470 Machine Learning II (3 credits)

MINOR IN MANAGEMENT INFORMATION SYSTEMS (21 CREDITS)

This minor offers exposure to the fundamentals of information systems.

Courses Required for the Minor:

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)

Three courses from the list below (9 credits):

CIS 125 Information Security Policy Analysis and Implementation
CIS 250 Algorithms and Data Structures
CIS 330 Database Management Systems
CIS 375 Software Engineering I
CIS 472 Android Programming or CIS 473 iOS Programming
CIS 475 Software Engineering II

CERTIFICATES

CERTIFICATE IN CYBERSECURITY

The certificate provides a solid foundation in cybersecurity and is designed with someone who has knowledge of a programming language but with little background in cybersecurity.

Courses Required for the Certificate (12 credits)

Level 1 certificate (12 credits): Designed for a person with 2 or more years of experience in the IT field with little or no experience in cybersecurity.

CIS 125: Introduction to Cybersecurity, Cyber Crime and Policies

Plus three additional 300 or 400-level cybersecurity major CIS courses, one of which may be a general computer science course that is a prerequisite or co-requisite for a specific cybersecurity course.

Level 2 certificate (12 credits): Designed for a person with 2 or more years of experience in the IT field with some experience in cybersecurity.

Four 300 or 400-level cybersecurity major CIS courses, one of which may be a general computer science course that is a prerequisite or co-requisite for a specific cybersecurity course.

CERTIFICATE IN WEB DEVELOPMENT AND DESIGN

This certificate provides a solid foundation in all aspects of website development: graphics design, programming, and installation. See certificate program in the undergraduate academic policy and regulations section of this catalog.

Courses Required for the Certificate: (23 credits)

ART 115 Introduction to Graphic Design (3 credits)
ART 202 Introduction to Web Design (3 credits)
ART 302 Web Design II (3 credits)
CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 215 Database Fundamentals and Web Server Programming (3 credits)
CIS 315 Advanced SSP (Server-Side Programming) (3 credits)

CONCENTRATIONS

Concentration in Cybersecurity (15 credits)

This concentration provides a foundation in cybersecurity and some of its applications.

Courses Required for the Concentration:

CIS 125: Introduction to Cybersecurity, Cyber Crime and Policies (3)

Two of the following three pairs of courses (12 credits):

CIS 355 Principles of Operating Systems **AND** CIS 356 Operating System Security and Administration

CIS 340 Concepts of Telecommunications and Networking **AND** CIS 345 Network Security and Management

CIS 380 Web Development Security **AND** CIS 415 Server Security and Maintenance /Troubleshooting

Concentration in Mathematics for Middle School (23 credits)

This concentration offers majors in middle school education exposure to areas of higher mathematics which will enhance their understanding of the middle school mathematics curriculum. It is intended to be one of two areas of concentration for middle school educators who wish to pursue two different concentration areas. A student must successfully complete, at Fontbonne, a minimum of 50 percent of the credit hours required for the concentration. See the middle school education major under the department of education/special education section of this catalog.

Courses Required for the Concentration:

MTH 110 PreCalculus (4 credits) (if needed)
MTH 115 Introduction to Statistics (3 credits)
MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 320 Elements of Geometry (3 credits)
EDU 313 Middle/Secondary Methods with Practicum (3 credits)

One of the following two courses (3 credits):

MTH 325 Theory and Applications of Probability
MTH 430 Algebraic Structures

GENERAL STUDIES MAJOR

The general studies major offers students a path to graduation that combines generalized study with disciplinary focus, leading to a Bachelor of Arts degree. The department of mathematics and computer science offers the general studies major with the following emphases: applied mathematics, computer science and management information systems.

Major requirements include:

- Residency, Major, General Education, and Graduation Requirements as described in the Fontbonne University Catalog.
- A minimum GPA of 2.0 in the major is required for graduation.
- A minimum of 18 hours of course work in an area of emphasis, 15 hours of electives, as defined by departments, and a capstone experience.

Emphasis in applied mathematics (19 credits)

Courses required for the emphasis:

MTH 115 Introduction to Statistics (3 credits)
MTH 120 Discrete Mathematics (3 credits)
MTH 150 Calculus with Analytic Geometry I (4 credits)
MTH 498 Senior Portfolio (1 credit)

MTH 499 Senior Synthesis (3 credits)

Two courses from the following (5-7 credits)

MTH 151 Calculus with Analytic Geometry II
MTH 300 Modeling and Numerical Approximation
MTH 305 Readings in the History of Mathematics
MTH 310 Differential Equations
MTH 315 Advanced Statistics
MTH 316 Non parametric statistics
MTH 320 Elements of Geometry

Emphasis in computer science (23 credits):

Courses required for the emphasis:

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (4 credits)
CIS 250 Algorithms and Data Structures (4 credits)
CIS 498 Senior Portfolio (1 credit)
CIS 499 Senior Synthesis (3 credits)

Two of the following six courses (6 credits):

CIS 310 Computer Architecture and Assembly Language
CIS 355 Operating Systems
CIS 375 Software Engineering I
CIS 421 Compiling Theory and Programming Languages
CIS 460 Artificial Intelligence
CIS 465 Robotics

Emphasis in management information systems (21 credits):

Courses required for the emphasis:

CIS 160 Computer Science I (4 credits)
CIS 161 Computer Science II (4 credits)
CIS 210 Object-Oriented Programming (3 credits)
CIS 498 Senior Portfolio (1 credit)
CIS 499 Senior Synthesis (3 credits)

Two of the following four courses (6 credits):

CIS 330 Database Management Systems
CIS 355 Operating Systems
CIS 375 Software Engineering I
CIS 475 Software Engineering II

ADVANCED PLACEMENT

An entering student who scores three, four or five on the Advanced Placement (AP) Test will receive equivalent placement and university credit. For students who score a three, four or five on the Calculus AB Examination, four credit hours are awarded for MTH150. For students who score a three, four or five on the Calculus BC Examination, eight credit hours are awarded for MTH150

and MTH151. For students who score a three, four or five on the Computer Science A Examination, credit may be given for a comparable computer science course per the agreement of the department. For students who score a three, four or five on the Statistics Examination, three credit hours are awarded for MTH115.

DUAL DEGREE PROGRAM IN ENGINEERING WITH THE UNIVERSITY OF MISSOURI–KANSAS CITY OR WITH WASHINGTON UNIVERSITY IN ST. LOUIS

Fontbonne University students may choose a dual degree program of study in collaboration with either the School of Computing and Engineering at the University of Missouri-Kansas City or the School of Engineering and Applied Science at Washington University in St. Louis. This program may be combined with any major, but is most easily achieved in conjunction with a major in applied mathematics or in biology. Because of the many engineering avenues, students must work closely with the dual degree advisor to map out a curriculum plan. A minimum cumulative grade point average (GPA) of B+ (3.25 on a 4.0 scale) or better, both overall and in science and mathematics courses, is required for admission to the engineering schools. Applicants with lower GPAs are considered on a case-by-case basis. Upon satisfactory completion of both programs, the student will be awarded bachelor of science degrees from both Fontbonne University and the University of Missouri-Kansas City or from both Fontbonne University and Washington University in St. Louis.

COURSES

BIOINFORMATICS COURSES

BNF 200 Scientific Computing Languages (3 credits)

Covers an introduction to scripting languages and their applications to scientific data (currently Python programming language and the R-statistical analysis program will be taught). Prerequisites: (MTH 125 or MTH 115) and BIO 112 (recommended for Biology majors and for Bioinformatics majors or minors). SP

BNF 210 Sequence, Evaluation and Structure (3 credits)

Provides an overview of bioinformatics, covering a variety of techniques used to analyze biological sequences. Topics include public sequence databases, Basic Local Alignment Research Tool (BLAST), pairwise and multiple sequence alignment, molecular phylogeny and evolution, protein analysis and proteomics, microarray expression profiling.

The code of ethics for professionals in bioinformatics will be addressed. Prerequisites BIO 212 and BNF 200. FA (odd)

BNF 280 Research in Bioinformatics (1-3 credits)

Provides an opportunity for a student to conduct research on a topic of interest in Bioinformatics. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in bioinformatics, computer science and statistics courses. Prerequisite: consent of the instructor and department chair. Offered as needed.

BNF 284 Internship in Bioinformatics (1-3 credits)

Provides a supervised, off-campus, field-based experience, in bioinformatics, at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: MTH 125 and BNF 200

BNF 301 Computational Genomics (3 credits)

Provides students with the knowledge and understanding of advanced topics in bioinformatics such as: next-generation sequencing technologies, genome assembly, comparative genomics and tools for visualizing genome data. Individual and organizational ethical responsibilities in bioinformatics research will be discussed. Prerequisites: BNF 200 and BIO 318 or concurrent.

BNF 480 Research in Bioinformatics (1-4 credits)

Provides an opportunity for a student to conduct research on a topic of interest in Bioinformatics. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in bioinformatics, computer science and statistics courses. Prerequisites: (Junior/senior status) and consent of the department chair and instructor. Offered as needed.

BNF 484 Internship in Bioinformatics (1-4 credits)

Provides a supervised, off-campus, field-based experience, in bioinformatics, at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisite: BNF 210. Offered as needed.

BNF 498 Senior Portfolio (1 credit)

Provides students with the opportunity to create and submit their final portfolio, which is required for graduation. Some of the items in the portfolio are: (1) a self-assessment in relation to how well the student outcomes for program were attained, (2) statements about the professional, ethical, legal, social and security issues and responsibilities associated with the chosen field of study, (3) statements about plans for future professional growth and (4) a professional resume. Prerequisites: Senior status and major approval. FA SP

BNF 499 Senior Synthesis (3 credits)

Allows the student to explore an area in her/his major that either (1) was not covered in the major curriculum or (2) can and will be explored in more depth than in previous coursework. Prerequisites: Senior Status and major approval. Prerequisite: Senior status and major approval. FA SP

COMPUTER SCIENCE, CYBERSECURITY AND MANAGEMENT INFORMATION SCIENCE COURSES**CIS 100 Computer Technology: Issues and Applications (3 credits)**

Provides an introduction to applications of information technology for non-computer science majors. The course covers general computer knowledge associated with computer history, hardware, software, operating systems, and computer networks. Students learn and/or reinforce skills related to word processing, spreadsheets, presentation and publishing tools as well as to emerging internet-based tools. Social and ethical issues related to technology are considered, such as piracy, viruses, and security issues. Course will include the development of an application project by the student. FA,SP, SU

CIS 103 Computer Technology: Applications for Educators (3 credits)

Provides an introduction to the uses of technology in an educational setting. Emphasis of the course will be on integrating technology with classroom instruction. Students will learn skills related to word processing, spreadsheets and presentations as well as to evolving internet-based technologies. Promoting life-long learning and an understanding of the legal and ethical use of computer/technology resources will be an integral part of the course. FA, SP

CIS 110 Computer Applications: Spreadsheet (3 credits)

Covers capabilities of Windows-based spreadsheet software. Presents spreadsheet terminology, basic commands, and features for data formatting, calculation, and creating tables and charts. Additional topics include building applications for data referencing, analysis and

reports, advanced functions, and macros. Course will include development of a significant spreadsheet project by the student. FA, SP

CIS 111 Computer Applications: Database (3 credits)

Covers the skills to design and implement a database as well as data entry, editing, and manipulation using Windows-based DBMS software. Includes applications of managing tables and files, using and creating queries, and designing forms and reports. Course will include development of a significant database project by the student. FA

CIS 120 Overview of Computer and Information Science (3 credits)

An introduction to computer and information science. Covers issues associated with both hardware and software, such as computer history, computer terminology, algorithm development and analysis with an emphasis on flowcharting, pseudo code and design, basic number systems, data storage, data manipulation, operating systems, networks, and computer engineering. Additional topics include programming languages, software engineering, data structures, file structures, database systems, the Internet, and artificial intelligence. Prerequisite: Grade of B or better in MTH 095 or competency in arithmetic and algebra. FA

CIS 125 Introduction to Cybersecurity and Cyber Crime and Policies (3 credits)

Introduces students to the fields of cybersecurity and cyber crime. Covers issues associated with different types of threats, attacks, and the methods employed to defend against these threats and attacks. Practical cryptography, securities of operating systems, computer networks, applications and other types of computer systems will also be introduced. The course also covers cybersecurity policies, analysis procedures, risk assessments, and implementation of security policies. SP

CIS 150 Fundamentals of Programming for Business (3 credits)

This course introduces programming for solving business-related application problems. Topics include program design, the integrated development environment, graphical user interface, data types, control structures, and sub/function procedures. Additional topics include database programming and exception handling. Offered as needed.

CIS 160 Computer Science I (4 credits)

Emphasis on programming in C and introduction to C++, including structural programming concepts, simple data types and structures, C and C++ syntax, operators, control structures and pointers. Lab exercises include techniques of coding, program design, and debugging. Students in this

course who are majoring in mathematics, computer science, cybersecurity or management information science must earn grades of B- or better in this course to progress to CIS 161 and/or CIS 210. Prerequisites: Grade of B or better in MTH 095 or competency in arithmetic and algebra. For CS, Cybersecurity or MIS majors, CIS120 is a pre- or co-requisite. FA

CIS 161 Computer Science II (4 credits)

Continuation of Computer Science I, with extensive programming in C++ language and introduction to Java. Includes string handling, file I/O, storage and static variables, structures, bitwise operations, and C++ library. Students in this course who are majoring in mathematics, computer science, cybersecurity or management information systems must earn grades of B- or better to progress to CIS 210 and above. Prerequisite: CIS 120 and CIS 160. SP

CIS 170 Visual Programming (3 credits)

Introduction to visual programming using Windows-based packages. Exploring tools and utilities of Windows graphic user interface and multimedia capacity, such as menus, buttons, and other controls. Topics also include using object-linking and embedding, dynamically-linked libraries, dynamic data exchange, and Internet-related applications. Lab exercises include language syntax and coding, data structures, links and controls, parameter passing. Prerequisite: CIS 160 or consent of instructor. Offered as needed.

CIS 210 Object-Oriented Programming (Java) (4 credits)

Introduction to concepts of abstract data type and inheritance. Topics include the fundamentals of object-oriented program design, object-oriented programming using Java. Lab exercises include introductory to intermediate level software analysis and design. Prerequisite: CIS 161. FA

CIS 215 Database Fundamentals and Web Server Programming (3 credits)

An introduction to server technology, database fundamentals and web server programming. Topics include system architecture, file servers, FTP servers, web servers, database servers with an emphasis on server installation and configuration as well as table design and management, creating and using queries and writing programs on the server to support a web site. Prerequisites: CIS 160. FA (Even)

CIS 250 Algorithms and Data Structures (4 credits)

Introduction to the principles of algorithm analysis, abstract data types covering stacks, queues, lists, trees and recursion, algorithms of sorting and searching. Additional topics include graph algorithms, text compression,

dynamic programming, and randomized algorithms. Prerequisite: CIS 210. SP

CIS 280 Research in Computer Science (1-3 credits)

Provides an opportunity for a student to conduct research on a topic of interest in computer science. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in computer science courses. Prerequisite: consent of the department chair and instructor. Offered as needed.

CIS 281 Research in Cybersecurity (1-3 credits)

Provides an opportunity for a student to conduct research on a topic of interest in cybersecurity. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in cybersecurity courses. Prerequisite: consent of the department chair and instructor. Offered as needed.

CIS 282 Research in Management Information Systems (1-3 credits)

Provides an opportunity for a student to conduct research on a topic of interest in management information systems. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in management information systems courses. Prerequisite: consent of the department chair and instructor. Offered as needed.

CIS 284 Internship in Computer Science (1-3 credits)

Provides a supervised, off-campus, field-based experience, in computer science at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: CIS 161. Offered as needed.

CIS 285 Internship in Cybersecurity (1-3 credits)

Provides a supervised, off-campus, field-based experience, in cybersecurity at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: CIS 161 and CIS 125. Offered as needed

CIS 286 Internship in Management Information Systems (1-3 credits)

Provides a supervised, off-campus, field-based experience, in management information systems, at an approved site

specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: CIS 161 Offered as needed

CIS 293 Topics in the Business Computing Environment (3 credits)

Course addresses topics of current interest in the business computing environment. Offered as needed.

CIS 300 Modeling and Numerical Approximation (3 credits)

Principles of model construction with selected case studies from various fields. Also, techniques of numerical approximation. Prerequisites: CIS 160 and MTH 150. SP (Odd)

CIS 310 Computer Architecture and Assembly Language (3 credits)

Topics covering theoretical aspects and concepts of hardware and computer systems including logic gates, combinational and sequential circuits, memory and registers, control logic design, instructions and addressing. Teaches programming in one assembly language. Prerequisites: CIS 161 and (CIS 120 or MTH 120). FA (Even)

CIS 315 Advanced Server-side Programming (3 credits)

This course teaches the advanced techniques of server-side programming over the Internet. Topics include using session control, accessing back-end database servers, E-commerce security issues, interacting with file systems, implementing secure transactions, and using network and protocol functions. Prerequisite: CIS 215. SP

CIS 316 Business Application Development (3 credits)

Course covers the essentials of the COBOL programming language in the context of business application development. Topics include the fundamental design principles of business applications, application development processes, and program implementations using COBOL. Prerequisite: CIS 150 or CIS 160 or consent of the instructor. Offered as needed.

CIS 330 Database Management Systems (3 credits)

Provides comprehensive coverage of relational databases including data management, database design and evaluation, query design and evaluation, web interfacing and database security. Students will learn all the steps from data modeling (ER diagrams) to table generation and linking to accessing and querying using SQL. Prerequisite: CIS 161. FA (Odd).

CIS 335 Survey of Data Analysis and Visualization

Provides a survey of the concepts and skills associated with data analytics and visualization. The course will focus on probability sampling and complex survey data collection methods used to analyze and visualize data collected in statistical surveys. Mobile, online and multi-mode surveys will be the sources of the data collection process. Application areas such as marketing and social engineering will be studied, along with the ethical considerations one must keep in mind when interpreting data. Prerequisites: BNF 200 and MTH 325 (or co-requisite). SP (Odd)

CIS 340 Concepts of Telecommunications and Networking (3 credits)

Introduction to the principles and practice of data communication and computer networking. Topics include the theoretical aspects of various methods, media, protocols, data compression, and security in telecommunication. Also includes lab exercises of network and remote access configuration and data exchange. Prerequisites: CIS 161 and (CIS 120 or MTH 120 and (MTH 150 or consent of the instructor). FA (Odd)

CIS 345 Network Security and Management (3 credits)

Covers network security and management with an emphasis on computer network security, implementation, and management. Topics include network core devices (such as routers and switches) setup, configuration, maintenance, security, and firewall management. Prerequisites: CIS 120 and CIS 125. CIS 340 is a pre- or co-requisite. FA (Odd)

CIS 355 Principles of Operating Systems (3 credits)

Topics cover the theoretical aspects and concepts of operating systems including system structures, scheduling, concurrent processes and deadlock handling, storage and file management, system protection and security. Also includes lab exercises in UNIX system configuration. Prerequisites: (CIS 120 or MTH 120). SP (Even)

CIS 356 Operating System Security and Administration (3 credits)

Covers operating system security and administration with an emphasis on operating system installation, configuration, administration, and security. Topics include operating system setup, user account control, file system protection, activity logging, system call auditing, address space management, and intrusion detections. Prerequisites: CIS 120, CIS 125 and CIS 161. CIS 355 is a pre- or co-requisite. SP (Even)

CIS 375 Software Engineering I (3 credits)

Course introduces classical and object-oriented software engineering principles. Topics include the scope of software engineering, the software process, software life cycle models, documentation, tools, testing, quality assurance, project management, object-oriented analysis and design, system views, patterns, and modeling using UML, in the context of generic object-oriented development process. Students are required to design and build software projects through team effort. The projects cover the principal system development life-cycle phases. Prerequisite: CIS 161. FA (Even)

CIS 380 Web Development Security (3 credits)

Covers web development security with an emphasis on the fundamental principles of security in web applications. Topics include web browser security, server-side web application security and web database security. Prerequisites: CIS 120 and CIS 125. CIS 215 FA (Even)

CIS 385 Principles of Cryptography (3 credits)

Introduces the fundamentals of cryptography including the concept of obscuring functions, cryptographic techniques, types of ciphers, proper use of cyphers, ethical uses of cryptography and decryption practices. Topics also include randomness, polymorphism and current trends in cryptography. Prerequisites: CIS 125 and MTH 120. FA (Even).

CIS 390 Personal Computer Security and Maintenance (3 credits)

Covers methods to keep personal computers running efficiently and the information housed on those computers safe. Provides practical information on computer operation and surveys information storage practices and common hacking techniques employed against personal computers. Prerequisite: CIS 125. SP (Even).

CIS 392 Ethical Hacking (3 credits)

Introduces the tools and techniques associated with the cybersecurity practice known as ethical hacking or penetration testing. The course covers not only laws and regulations, but also the steps in penetration testing such as planning, scanning, exploiting and result reporting. Students are taught how system vulnerabilities are discovered and exploited. They will also learn how to avoid vulnerabilities and how to react and defend if they do occur as well as how to design controls to prevent future attacks in real-life situations. Other topics include: system, wireless, web, and database hacking; penetration testing methods and tools. The course is designed to provide a rich learning experience to students through the use of hands-on exercises and discussions on the course material. Prerequisites: CIS 125 and CIS 161. CIS 356 is a pre or co-requisite. SP (Odd)

CIS 394 Topics in Computer Science (1-4 credits)

Course generated by the department to supplement regular course listings. Addresses topics in computer science. Prerequisite: CIS 250 and (Junior/senior status or consent of instructor). Offered as needed.

CIS 395 Topics in Cybersecurity (1-4 credits)

Course generated by the department to supplement regular course listings. Addresses topics in cybersecurity. Prerequisite: CIS 250 and (Junior/senior status or consent of instructor). Offered as needed.

CIS 396 Topics in Management Information Systems (1-4 credits)

Course generated by the department to supplement regular course listings. Addresses topics in management information systems. Prerequisite: CIS 210 (Junior/senior status or consent of instructor). Offered as needed.

CIS 410 Wireless Communication and Mobile Forensics (3 credits)

Covers the fundamental principles of wireless communication and mobile forensics. Topics include wireless links, protocols, cellular access, mobile Internet Protocol (IP), and mobility management. The techniques of collecting and analyzing information from mobile devices for forensic investigations will also be studied. Prerequisites: CIS 120 and CIS 125. SP (Odd)

CIS 415 Server Security and Maintenance/Troubleshooting (3 credits)

Covers the fundamental security principles of different types of servers, such as file servers, database servers, web servers, File Transfer Protocol (FTP) servers, mail servers, and Domain Name System (DNS) servers. Server installation, configuration, maintenance, and troubleshooting will be studied. Prerequisites: CIS 120, CIS 125 and CIS 356 FA (Even)

CIS 421 Compiling Theory and Programming Languages (3 credits)

Comparative study of programming languages and concepts such as grammars and parse trees, interpretation and compilation, and generation of optimal code. A number of programming languages will be studied relative to their history, design implementation, and evaluation. Prerequisites: CIS 250 and (CIS 120 or MTH 120). SP (Even)

CIS 425 Digital Forensics and Analysis (3 credits)

Presents the technical and legal issues facing computer crime investigators and digital forensic examiners. Students will learn effective and appropriate forensic response strategies to support cyber crime investigative efforts. The focus is on acquiring the skills needed to

identify and collect potential digital evidence, to analyze that evidence using chain of custody and to report forensic findings. Prerequisite: CIS 125 and CIS 356. FA (Odd)

CIS 455 Machine Learning I (3 credits)

Covers data analysis methods to recognize trends and patterns of big data. The emphasis will be on classification, regression and model fitting. Application areas such as healthcare, finance, game playing, marketing and internet fraud detection will be studied. Prerequisites: MTH 115 and BNF 200. FA (Odd)

CIS 460 Artificial Intelligence (3 credits)

A survey of concepts, techniques, and applications of AI, including knowledge abstraction and representation, knowledge-based systems, heuristic searching, natural language understanding, machine learning, and automated reasoning. Use of LISP or PROLOG, or other appropriate language, to develop a substantial project in expert systems is required. Prerequisite: CIS 250 or consent of the instructor. Offered as needed.

CIS 465 Robotics (3 credits)

Introduces students to the basics of modeling, design, planning, programming and control of robot systems. Topics include an exploration of the principles and algorithms for computation in the physical world, kinematics, geometric reasoning, motion planning, behavior-based artificial intelligence and some philosophical questions pertaining to the nature of intelligence in the physical world. Prerequisites: CIS 210, CIS 250, MTH 151 FA (Even)

CIS 470 Machine Learning II (3 credits)

Focuses on deep learning, which is a subset of machine learning, to predict the characteristics of data based on the hierarchical structure of the data. Deep learning covers advanced supervised/unsupervised methods of classification and regression, structured prediction and anomaly detection with an emphasis on the development of the algorithms used to simulate high-level abstractions of data based on low-level layers. Models such as unsupervised Bayesian, Inference procedures and non-parametric models will be discussed. Prerequisites: MTH 455 SP (Even)

CIS 472 Android Programming (3 credits)

Provides students with the fundamental knowledge and skills needed to design and build Android apps using the most current Android programming platform. Students will complete multiple Android apps that run on a real Android smartphone/tablet, starting from simpler ones to complex ones. (Note, students may choose either CIS 372 or 373 to fulfill an elective choice for the BS in computer science or management information systems.) Prerequisite: CIS 210. SP (odd)

CIS 473 iOS Programming (3 credits)

Provides students with the fundamental knowledge and skills needed to design and build iOS apps using the most current iOS programming platform. Students will complete multiple iOS applications that run on iPhones/iPads, starting from simple ones to complex ones. (Note, students may choose either CIS 372 or 373 to fulfill an elective choice for the BS in computer science or management information systems.) Prerequisite: CIS 161. SP (even)

CIS 475 Software Engineering II (3 credits)

Continuation of Software Engineering I. Topics include the scope of system design, object analysis and design, implementing, testing, configuration management, and use of various tools that aid software development. Students are required to design, implement, test, and release software projects through team effort. The projects cover the principal system development lifecycle phases. Prerequisite: CIS 375 SP (Odd)

CIS 480 Research in Computer Science (1-4 credits)

Provides an opportunity for a student to conduct research on a topic of interest in computer science. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in computer sciences courses. Prerequisites: (junior/senior status) and the consent of the department chair and instructor. Offered as needed.

CIS 481 Research in Cybersecurity (1-4 credits)

Provides an opportunity for a student to conduct research on a topic of interest in cybersecurity. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in cybersecurity courses. Prerequisites: (junior/senior status) and the consent of the department chair and instructor. Offered as needed.

CIS 482 Research in Management Information Systems (1-4 credits)

Provides an opportunity for a student to conduct research on a topic of interest in management information systems. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in management information system courses. Prerequisites: (junior/senior status) and the consent of the department chair and instructor. Offered as needed.

CIS 484 Internship in Computer Science (1-4 credits)

Provides a supervised, off-campus, field-based experience, in computer science at an approved site specifically related to the career goals of the student. The purpose of the

course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: at least two 300-level computer science courses. Offered as needed.

CIS 485 Internship in CyberSecurity (1-4 credits)

Provides a supervised, off-campus, field-based experience, in cybersecurity at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: at least two 300-level cybersecurity courses. Offered as needed.

CIS 486 Internship in Management Information Systems (1-4 credits)

Provides a supervised, off-campus, field-based experience in management information systems, at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: at least two 300-level computer science courses. Offered as needed.

CIS 490 Independent Study in Computer Science (1-4 credits)

Study in a specialized area, to be arranged according to student need and interest. Prerequisite: Junior/senior status and consent of instructor. Offered as needed.

CIS 491 Independent Study in CyberSecurity (1-4 credits)

Study in a specialized area, to be arranged according to student need and interest. Prerequisite: Junior/senior status and consent of instructor. Offered as needed.

CIS 492 Independent Study in Management Information Systems (1-4 credits)

Study in a specialized area, to be arranged according to student need and interest. Prerequisite: Junior/senior status and consent of instructor. Offered as needed.

CIS 494 Advanced Topics in Computer Science (1-4 credits)

Topics similar to those offered in CIS 394, offered on an as-needed basis, at a more advanced level. Prerequisites: CIS 250 and senior status. Offered as needed.

CIS 495 Advanced Topics in Cybersecurity (1-4 credits)

Topics similar to those offered in CIS 395, offered on an as-needed basis, at a more advanced level. Prerequisites: CIS 250 and senior status. Offered as needed.

CIS 496 Advanced Topics in Management Information Systems (1-4 credits)

Topics similar to those offered in CIS 396, offered on an as-needed basis, at a more advanced level. Prerequisites: CIS 250 and senior status. Offered as needed.

CIS 498 Senior Portfolio (1 credit)

Provides students with the opportunity to create and submit their final portfolio, which is required for graduation. Some of the items in the portfolio are: (1) a self-assessment in relation to how well the student outcomes for program were attained, (2) statements about the professional, ethical, legal, social and security issues and responsibilities associated with the chosen field of study, (3) statements about plans for future professional growth and (4) a professional resume. Prerequisites: Senior status and major approval. FA SP

CIS 499 Senior Synthesis (3 credits)

Allows the student to explore an area in her/his major that either (1) was not covered in the major curriculum or (2) can and will be explored in more depth than in previous coursework. Prerequisites: Senior Status and major approval. Prerequisite: Senior status and major approval. FA SP

MATHEMATICS COURSES

MTH 091 College Mathematics Skills (3 credits)

Emphasizes computing with whole numbers, fractions, decimals, and integers; solving word problems with whole numbers, fractions, decimals, and integers; solving basic linear equations; Coordinate geometry is introduced. In general, students must earn a grade of C- or better in this course to satisfy the prerequisite for further mathematics courses. However, students in this course who intend to choose a major in the department must earn grades of A- or better in this course to progress to MTH 095. Credit does not apply toward the 120 -hour degree requirement. Offered as needed.

MTH 095 Fundamentals of Algebra (4 credits)

Study of basic algebra required for all mathematics courses at Fontbonne. Topics include: real numbers, exponents, radicals, rational expressions, linear equations and inequalities, polynomials, quadratic equations, systems of linear equations, functions, and graphing. In general, students must earn a grade of C- or better in this course to satisfy the prerequisite for further mathematics courses. However, students in this course who intend to choose a major in the department must earn grades of A- or better in this course to progress to MTH 105 and/or CIS 160.

Prerequisite: A grade of C- or better in MTH 091 or competency in arithmetic. Credit will be applied as elective credit to the 120-hour degree requirement. FA, SP

MTH 100 Topics in Algebra for Statistics (2 credits)

This course covers the essential topics in algebra that are needed specifically to do common statistical calculations. Topics include: sets, signed numbers, exponents and radicals, algebraic and rational expressions, factoring, linear equations, an introduction to two-dimensional graphing, and an introduction to quadratic equations. Application problems are included. (Topics may be added at the instructor's discretion, as time allows, but not deleted from the preceding list.) Offered as needed.

MTH 102 Mathematics for Elementary School Teachers: Number Systems, Geometry and Measurement (3 credits)

Problem solving, elementary set theory and logic, development of the real number system. Topics in geometry and statistics. Enrollment limited to students in the following programs: Pathways, Deaf Education, and Early Childhood, and to students in Elementary Education/Special Education, who have transferred into Fontbonne with previous mathematics credit. Prerequisites: Grade of C- or better in MTH 095 or consent of the instructor. SP

MTH 103 Excursions into Modern Mathematics (3 credits)

This course presents mathematics in such a way that the student can see immediate connections between what is learned in the mathematics classroom and real-life problems. It is geared toward liberal arts majors. The choice of topics is such that a heavy mathematical infrastructure is not needed. A fundamental objective of the course is to develop an appreciation for the aesthetic elements of mathematics. Prerequisites: Grades of C- or better in MTH 095 or competency in arithmetic and algebra. SP

MTH 104 Mathematics for Elementary School Teachers: Number Systems (3 credits)

Examines the structures and properties of mathematics, while focusing on the development of problem-solving skills. Includes the study of sets, functions, whole numbers, fractions, number theory and integers. Considers applications of rational numbers, decimals, and percents. Intended for prospective elementary school teachers. Utilizes appropriate grade-level technology. Grade of C- or better in MTH 095 or consent of instructor. FA

MTH 105 College Algebra (4 credits)

Topics covered: sets, number systems, polynomials, equations and graphing, inequalities, relations and functions, systems of equations, exponential and

logarithmic equations, rational zeros of polynomials, matrices and determinants, sequences and series. Students in this course who choose a major in the department must earn grades of B- or better in this course to progress to MTH 150. Prerequisites: Grade of C- or better in MTH 095, or competency in arithmetic and algebra. FA, SP

MTH 106 Mathematics for Elementary School Teachers: Geometry and Measurement (3 credits)

Examines the structures and properties of mathematics through problem solving. Includes the study of geometry, measurement and probability and statistics. Utilizes appropriate grade-level technology. Intended for prospective elementary school teachers. (Students, who have previously completed MTH 102, cannot receive credit for this course.) Prerequisites: Grade of C- or better in MTH 104 or its equivalent. SP

MTH 108 Trigonometry (2 credits)

Covers the standard introductory trigonometry topics: the six standard trigonometric functions, right triangle trigonometry, radian measure, graphs of function and their inverses, identities and formulas, equations and triangles. MTH 108 or MTH 110 is a prerequisite for MTH 150. Offered as needed.

MTH 110 Precalculus (4 credits)

Prepares students for MTH 150, Calculus with Analytic Geometry I. The course is an in-depth study of the concept of a function. Several classes of functions including linear, quadratic, polynomial, rational, exponential, logarithmic, and trigonometric functions are studied. Within each class of functions, characteristics of the function are emphasized such as the basic form and graph, equations and inequalities associated with the function, and applications. Both algebraic and graphical techniques will be used throughout the course. Prerequisite: Grade of B or higher in MTH 095 or equivalent knowledge. FA

MTH 115 Introduction to Statistics (3 credits)

Topics covered: descriptive statistics, probability, binomial, chi-squared and normal probability distributions, tests of hypotheses, linear correlation and regression, and analysis of variance. Prerequisites: Grades of C- or better in MTH 095 or competency in arithmetic and algebra. FA, SP

MTH 120 Discrete Mathematics (3 credits)

Topics include: truth tables, propositional logic, sets, binary and equivalence relations, functions, matrices, binary, octal and hexadecimal number systems, combinatorics, proof by induction and recursion, and algorithms. Prerequisite: Competency in arithmetic and algebra. FA

MTH 125 Biostatistics (3 credits)

Introduces the application of statistical concepts to biological problems over a broad range of fields including biological sciences, medicine and public health. The evaluation of experimental design in biological studies will be addressed. Topics covered include: scientific method, data representation, descriptive statistics, inferential statistics and data analysis, normal probability distributions, estimation and hypotheses testing, chi-squared distributions and the analysis of variance. An appropriate statistical program (currently R) will be used as a tool in the course. Prerequisite: MTH 105 or MTH 110 (or equivalent knowledge) and BIO 112 or an introductory biology course (can be concurrent). FA

MTH 150 Calculus with Analytic Geometry I (4 credits)

Differential and integral calculus of the algebraic and transcendental functions associated with analytic geometry. Prerequisites: Three years of high school mathematics including trigonometry with grades of B or better, or MTH 110 (with a grade of C- or better), or (MTH 105 and MTH 108) with grades of C- or better, or the consent of the instructor. SP

MTH 151 Calculus with Analytic Geometry II (4 credits)

A continuation of MTH 150, continuation of differential and integral calculus; infinite series. Prerequisite: MTH 150 with grades of C- or better. FA

MTH 200 Linear Algebra (3 credits)

Topics include: vector spaces, linear transformations, and matrices. Pre- or co-requisite: MTH 151. FA (Even)

MTH 250 Calculus with Analytic Geometry III (4 credits)

Vector calculus, the differential, multivariate calculus with applications. Prerequisite: MTH 151. SP

MTH 280 Research in Mathematics (1-3 credits)

Provides an opportunity for a student to conduct research on a topic of interest in mathematics. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in applied mathematics courses. Prerequisite: consent of department chair and instructor. Offered as needed.

MTH 284 Internship in Applied Mathematics (1-3 credits)

Provides a supervised, off-campus, field-based experience, in applied mathematics, at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at

the internship site. Offered on P/F basis. Prerequisites: MTH 115 and MTH 150. Offered as needed.

MTH 294 Topics in Mathematics (1-3 credits)

Course generated by the department to supplement regular course listings. Addresses topics in mathematics. Offered on a one-time or irregular basis.

MTH 300 Modeling and Numerical Approximation (3 credits)

Principles of model construction with selected case studies from various fields. Also, techniques of numerical approximation. Prerequisites: MTH 150 and CIS 160. SP (Odd)

MTH 305 Readings in the History of Mathematics (2 credits)

Readings in the history of mathematics and in the mathematics contributions of both Western and non-Western cultures. The interplay between mathematics and culture is emphasized. Prerequisites: MTH 150; MTH 120. SP (Odd)

MTH 310 Differential Equations (3 credits)

Techniques for solving ordinary differential equations. Investigation of existence and uniqueness of solutions; a variety of applications. Prerequisite: MTH 151. SP (Odd)

MTH 315 Advanced Statistics (3 credits)

Covers widely used statistical tools such as linear and nonlinear regression, analysis of variance, expected mean squares and pooling. Students will use a statistical package to analyze data sets. Prerequisites: (MTH 115 or MTH 125) and MTH 150 or consent of instructor. FA (Even)

MTH 316 Non-Parametric Statistics (3 credits)

An introduction to nonparametric statistical procedures. Topics include order statistics, rank order statistics and scores, tests of goodness of fit, linear rank tests for location and scale problems, applications. Prerequisite: MTH 115. FA (Odd)

MTH 320 Elements of Geometry (3 credits)

Transformational approach to isometries and similarities; studies of Euclidean and non-Euclidean geometries. Prerequisite: MTH 150 or consent of instructor. FA (Odd)

MTH 325 Theory and Applications of Probability (3 credits)

Introduces the mathematical treatment of random phenomena occurring in the natural, physical, and social sciences. Topics include combinatorial analysis, binomial distribution, Poisson and normal approximation, random variables and probability distributions, generating functions, Markov chains applications. Prerequisites: MTH 115 or MTH 125 and MTH 150. SP (odd)

MTH 335 Survey of Data Analysis and Visualization

Provides a survey of the concepts and skills associated with data analytics and visualization. The course will focus on probability sampling and complex survey data collection methods used to analyze and visualize data collected in statistical surveys. Mobile, online and multi-mode surveys will be the sources of the data collection process. Application areas such as marketing and social engineering will be studied, along with the ethical considerations one must keep in mind when interpreting data. Prerequisites: BNF 200 and MTH 325 (or co-requisite). SP Odd

MTH 350 Methods of Teaching Mathematics in the Early Childhood and Elementary School (3 credits)

Covers methods for teaching the real number system, probability, statistics, geometry, measurement and algebra. The study and implementation of various models of teaching, including differentiated instruction and technology integration are included. Education certification majors only. Prerequisite: MTH 102 or (MTH 104 and MTH 106). FA, SP

MTH 360 Teaching Mathematics in Middle/Secondary Schools (3 credits)

Study of models of teaching mathematics, diagnostic mathematics, and remedial methods at the middle school or secondary level. Education certification majors only. Prerequisite: Junior or senior status. (Background check required) Offered as needed.

MTH 385 Principles of Cryptography (3 credits)

Introduces the fundamentals of cryptography including the concept of obscuring functions, cryptographic techniques, types of ciphers, proper use of cyphers, ethical uses of cryptography and decryption practices. Topics also include randomness, polymorphism and current trends in cryptography. Prerequisites: CIS 225 (only required for cybersecurity majors) and MTH 120. FA (Even).

MTH 430 Algebraic Structures (3 credits)

Covers algebraic structures including Boolean algebra, groups, rings, integral domains and fields and their applications which may include: cryptography, coding

theory, color patterns, and switching circuits..

Prerequisites: MTH 120 and MTH 150. SP (Even)

MTH 455 Machine Learning I (3 credits)

Covers data analysis methods to recognize trends and patterns of big data. The emphasis will be on classification, regression and model fitting. Application areas such as healthcare, finance, game playing, marketing and internet fraud detection will be studied. Prerequisites: MTH 115 and BNF 200. FA Odd Years

MTH 470 Machine Learning II (3 credits)

Focuses on deep learning, which is a subset of machine learning, to predict the characteristics of data based on the hierarchal structure of the data. Deep learning covers advanced supervised/unsupervised methods of classification and regression, structured prediction and anomaly detection with an emphasis on the development of the algorithms used to simulate high-level abstractions of data based on low-level layers. Models such as unsupervised Bayesian, Inference procedures and non-parametric models will be discussed. Prerequisites: MTH 455 SP Even

MTH 480 Research in Mathematics (1-4 credits)

Provides an opportunity for a student to conduct research on a topic of interest in mathematics. Research will be conducted in a non-classroom, individualized environment utilizing the skills and knowledge obtained in applied mathematics courses. Prerequisite: (junior/senior status) and consent of department chair and instructor.

MTH 484 Internship in Applied Mathematics (1-4 credits)

Provides a supervised, off-campus, field-based experience, in applied mathematics, at an approved site specifically related to the career goals of the student. The purpose of the course is to integrate and apply academic knowledge and skills to the professional environment. Credits are determined by the number of hours that a student works at the internship site. Offered on P/F basis. Prerequisites: At least two 300-level mathematics courses.

MTH 490 Independent Study (1-4 credits)

Study in a specialized area, to be arranged according to student need and interest. Prerequisite: Junior or senior status.

MTH 494 Advanced Topics in Mathematics (1-4 credits)

Course generated by the department to supplement regular course listings. Addresses topics in mathematics. Prerequisite: Junior or senior status, or consent of instructor. Offered as needed.

MTH 498 Senior Portfolio (1 credit)

Provides students with the opportunity to create and submit their final portfolio, which is required for graduation. Some of the items in the portfolio are: (1) a self-assessment in relation to how well the student outcomes for program were attained, (2) statements about the professional, ethical, legal, social and security issues and responsibilities associated with the chosen field of study, (3) statements about plans for future professional growth and (4) a professional resume. Prerequisites: Senior status and major approval. FA SP

MTH 499 Senior Synthesis (3 credits)

Allows the student to explore an area in her/his major that either (1) was not covered in the major curriculum or (2) can and will be explored in more depth than in previous coursework. Prerequisites: Senior Status and major approval. Prerequisite: Senior status and major approval. FA SP