

# DATA SCIENCE, MS

## Vision Statement

The vision of the Master of Science in data science program is to provide flexible, innovative, and technologically current education to rising data professionals who want to prepare for corporate leadership positions through their functional expertise. The interdisciplinary data science program brings together thought leaders in the fields of business, information technology, mathematics, and other units at UNO, including international university partners and local businesses.

This interdisciplinary graduate program is designed to be completed in 24 months. The curriculum includes course modules on topics that address the following major themes: data organization, manipulation, cleaning, and visualization; data analytics; working with massive amounts of data; dealing with missing and messy data; understanding the value of data and creating data products.

## Program Contact Information

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**Program Website (<https://www.unomaha.edu/graduate-studies/prospective-students/ms-data-science.php>)**

## Admissions

General Application Requirements and Admission Criteria (<http://catalog.unomaha.edu/graduate/admission/>)

## Program-Specific Requirements

### Application Deadlines (Spring 2025 and Fall 2025)

- Spring: December 15
- Fall: July 1

## Other Requirements

- Minimum GPA of at least 3.0 in undergraduate degree.
- **English Language Proficiency:** Applicants are required to have a command of oral and written English. Those who do not hold a baccalaureate or other advanced degree from the U.S., **OR** a baccalaureate or advanced degree from a pre-determined country on the waiver list (<https://www.unomaha.edu/office-of-graduate-studies/admissions/entrance-exams.php>), must meet the minimum language proficiency score requirement in order to be considered for admission.
  - Internet-based TOEFL: 80, IELTS: 6.5, PTE: 53, Duolingo: 105
- **Resume:** An up-to-date resume with details about all relevant IT experience and skills.
- **Letters of Recommendation:** Three letters of recommendation are required
- **Interview:** A personal, telephone or Skype interview is encouraged, but is optional.

## Foundation Courses

Students must have completed basic courses in the following areas, either as an undergraduate student or prior to enrolling in the first data science course.

- Introduction to Programming: one semester of Java, Python, C++, or other approved programming course
- Statistics: one semester of undergraduate statistics

Foundation courses do not count towards the plan of study/degree requirements.

## Degree Requirements

Code	Title	Credits
<b>Core Courses</b>		<b>18</b>
STAT 8416	INTRODUCTION TO DATA SCIENCE	
STAT 8426	EXPLORATORY DATA VISUALIZATION AND QUANTIFICATION	
ECON 8320	TOOLS FOR DATA ANALYSIS	
ECON 8310	BUSINESS FORECASTING	
or BSAD 8080	BUSINESS FORECASTING	
ISQA 8206	INFORMATION AND DATA QUALITY MANAGEMENT	
ITIN 8300	RESEARCH FOUNDATIONS	
or ISQA 8060	RESEARCH IN MIS	
<b>Concentration</b>		<b>12</b>
Select one of the five concentration areas.		
<b>Exit Requirement (Project or Thesis)</b>		<b>6</b>
Specific exit requirements for each concentration are included on the Concentrations tab.		
<b>Total Credits</b>		<b>36</b>

## Exit Requirements

- Project Option: Complete 3 hours of project credit and 3 hours of additional electives.
- Thesis 6 Credits
  - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis.

## Concentrations

### Business Concentration

Code	Title	Credits
<b>Select 12 hours from the following:</b>		<b>12</b>
ACCT 8080	CURRENT TECHNOLOGY USE IN ACCOUNTING	
BSAD 8376	SUPPLY CHAIN ANALYTICS	
BSAD 8066	HEALTHCARE ANALYTICS FOR BUSINESS	
BSAD 8396	MARKETING ANALYTICS	
BSAD 8426	BUSINESS DEMOGRAPHICS	
BSAD 8910	SPECIAL TOPICS IN BUSINESS	
ECON 8300	ECONOMETRICS	
ECON 8306	QUANTITATIVE APPLICATIONS IN ECONOMICS AND BUSINESS	
ECON 8316	BUSINESS INTELLIGENCE AND REPORTING	
ECON 8330	DATA ANALYSIS FROM SCRATCH	
ECON 8910	SPECIAL STUDIES IN ECONOMICS (Sports Economics)	
<b>Total Credits</b>		<b>12</b>

## Exit Requirement

- Project Option - Complete ECON 8330 and 3 additional hours from any of the concentration areas or PSYC 9020, PSYC 9090, PSYC 9100, PSYC 9120, PSYC 9910 (Structure Equation/Hierarchical Linear Modeling), PSYC 9920 (Multilevel Modeling)

- Thesis Option - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis. The chair of the supervisory committee must be from the College of Business Administration.

## Data Science for Health Sciences Concentration

Code	Title	Credits
BMI 8100	INTRODUCTION TO BIOMEDICAL INFORMATICS	3
<b>Select 9 hours from the following:</b>		<b>9</b>
BIOI 8850	SPECIAL TOPICS IN BIOINFORMATICS	
BMI 8020	ADVANCED COURSE IN BIOINFORMATICS	
BMI 8866	BIOINFORMATICS ALGORITHMS	
BMI 8896	COMPUTERIZED GENETIC SEQUENCE ANALYSIS	
CSCI 8156	GRAPH THEORY & APPLICATIONS	
STAT 8456	INTRODUCTION TO MACHINE LEARNING AND DATA MINING	
<b>Total Credits</b>		<b>12</b>

### Exit Requirement

- Project Option - Complete STAT 8960, STAT 8950/DSCI 8950 and 3 additional hours from any of the concentration areas or PSYC 9020, PSYC 9090, PSYC 9100, PSYC 9120, PSYC 9910 (Structure Equation/Hierarchical Linear Modeling), PSYC 9920 (Multilevel Modeling)
- Thesis Option - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis. The chair of the supervisory committee must be from the Department of Mathematical and Statistical Sciences.

## Information Technology Concentration

Code	Title	Credits
<b>Select 12 hours from the following:</b>		<b>12</b>
ISQA 8016	BUSINESS INTELLIGENCE	
ISQA 8156	ADVANCED STATISTICAL METHODS FOR IS&T	
ISQA 8160	APPLIED DISTRIBUTION FREE STATISTICS	
ISQA 8340	APPLIED REGRESSION ANALYSIS	
ISQA 8410	DATA MANAGEMENT	
ISQA 8450	NOSQL AND BIG DATA TECHNOLOGIES	
ISQA 8460	INTERNET OF THINGS (IOT), BIG DATA AND THE CLOUD	
ISQA 8600	FROM DATA TO DECISIONS	
ISQA 8700	DATA MINING: THEORY AND PRACTICE	
or CSCI 8350	DATA WAREHOUSING AND DATA MINING	
ISQA 8720	APPLIED STATISTICAL MACHINE LEARNING	
ISQA 8736	DECISION SUPPORT SYSTEMS	
ISQA 8750	STORYTELLING WITH DATA	
ISQA 8910	INFORMATION SYSTEMS INTERNSHIP	
ISQA 9120	APPLIED EXPERIMENTAL DESIGN AND ANALYSIS	
ISQA 9130	APPLIED MULTIVARIATE ANALYSIS	
CSCI 8476	PATTERN RECOGNITION	
CSCI 8856	DATABASE MANAGEMENT SYSTEMS	

CYBR 8396	MOBILE DEVICE FORENSICS
CYBR 8490	CYBER INVESTIGATIONS

**Total Credits** **12**

### Exit Requirement

- Project Option - Complete CSCI 8910 or STAT 8960 or STAT 8950/DSCI 8950 and 3 additional hours from any of the concentration areas or PSYC 9020, PSYC 9090, PSYC 9100, PSYC 9120, PSYC 9910 (Structure Equation/Hierarchical Linear Modeling), PSYC 9920 (Multilevel Modeling)
- Thesis Option - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis. The chair of the supervisory committee must be from the College of Information Science & Technology.

## Interdisciplinary Concentration

Code	Title	Credits
<b>Select 12 hours from any of the other concentrations, courses must be approved by your advisor.</b>		<b>12</b>
<b>Total Credits</b>		<b>12</b>

### Exit Requirement

- Project Option - Complete ECON 8330 or STAT 8960 or CSCI 8910 or STAT 8950/DSCI 8950 and 3 additional hours from any of the concentration areas or PSYC 9020, PSYC 9090, PSYC 9100, PSYC 9120, PSYC 9910 (Structure Equation/Hierarchical Linear Modeling), PSYC 9920 (Multilevel Modeling)
- Thesis Option - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis.

## Mathematics Concentration

Code	Title	Credits
<b>Select 12 hours from the following:</b>		<b>12</b>
STAT 8446	TIME SERIES ANALYSIS	
STAT 8436	LINEAR MODELS	
STAT 8456	INTRODUCTION TO MACHINE LEARNING AND DATA MINING	
STAT 8700	BAYESIAN STATISTICS	
STAT 8730	ADVANCED STATISTICAL MACHINE LEARNING	
STAT 8710	DESIGN AND ANALYSIS OF EXPERIMENTS	
MATH/CSCI 8306	DETERMINISTIC OPERATIONS RESEARCH MODELS	
MATH/CSCI 8316	PROBABILISTIC OPERATIONS RESEARCH MODELS	
MATH 8326	COMPUTATIONAL OPERATIONS RESEARCH	
MATH 8430	LINEAR PROGRAMMING	
MATH/CSCI 8520	ADVANCED TOPICS IN OPERATIONS RESEARCH	
MATH 8650	INTRODUCTION TO PROBABILITY MODELS	
MATH 8670	TOPICS IN PROBABILITY AND STATISTICS	
MATH 8440	NETWORK PROGRAMMING	

MATH 8460

INTEGER PROGRAMMING

**Total Credits****12****Exit Requirement**

- Project Option - Complete STAT 8960 or STAT 8950/DSCI 8950 and 3 additional hours from any of the concentration areas or PSYC 9020, PSYC 9090, PSYC 9100, PSYC 9120, PSYC 9910 (Structure Equation/Hierarchical Linear Modeling), PSYC 9920 (Multilevel Modeling)
- Thesis Option - All candidates should carefully review the Graduate College requirements for forming a Supervisory Committee, Thesis/Thesis Equivalent Proposal Approval forms and final approval and submission of a thesis. The chair of the supervisory committee must be from the Department of Mathematical and Statistical Sciences.

**Graduate Courses****BIOI 8850 SPECIAL TOPICS IN BIOINFORMATICS (3 credits)**

This course is intended to provide a mechanism for offering instruction in subject areas that are not covered in other regularly scheduled courses. In general, courses offered under the BIOI 8850 designation will focus on evolving subject areas in bioinformatics.

**Prerequisite(s):** Course prerequisites of a specific offering of BIOI 8850 will be determined by the supervising faculty member and will be identified in the course proposal. It is anticipated that permission of the faculty member teaching the course will be required.

**BMI 8000 ADVANCES IN BIOMEDICAL INFORMATICS (0 credits)**

BMI 8000 provides a regular forum for BMI graduate students, where the latest developments in the field of Biomedical Informatics are introduced and discussed. The course also functions as a central communication and collaboration hub for graduate students in BMI. Participation is required.

**Prerequisite(s):** Students in the MS in BMI and PhD in BMI program may register. Not open to non-degree graduate students.

**BMI 8020 ADVANCED COURSE IN BIOINFORMATICS (3 credits)**

This is a special topics course designed to explore the research interests of faculty and students. Therefore, topics may include, but are not limited to, such areas of study as next-generational sequencing, biological networks, proteomics, metabolomics, and biomedical informatics.

**Prerequisite(s):** Admission to the MS/PhD Program in the College of Information Science and Technology, or permission of the instructor. Not open to non-degree graduate students.

**BMI 8070 HEALTH INFORMATICS RESEARCH METHODS (3 credits)**

This is a foundational course for health informatics research methods. Health informatics is a broad term that denotes disciplines that encompass the use of computer and information science to manage all aspects of healthcare data and the use of healthcare information to foster better collaboration among a patient's various healthcare providers. This course takes a practical approach to understanding health informatics research methods through the use of real-life examples, step-by-step research method practices, and applying various analytical procedures. The course will guide the student through the process of designing research studies using a variety of research methods. Students are introduced to quantitative, qualitative and mixed methods designs through hands-on assignments and reviewing selected research studies. In addition, students will learn how to conduct a literature review. Students will learn about grant opportunities, the proposal writing process and IRB applications.

**Prerequisite(s):** Graduate student status and prior or concurrent enrollment in BMI 8100, or by instructor approval.

**BMI 8080 SEMINAR IN BIOMEDICAL INFORMATICS (3 credits)**

This is a variable-content course that engages students in current research in Biomedical Informatics and develops skills in the oral and written presentation of scientific research.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**BMI 8100 INTRODUCTION TO BIOMEDICAL INFORMATICS (3 credits)**

This course offers students an overview of the field of biomedical informatics, combining perspectives from computing, biosciences and medicine. The historical development of the field and its influence on biological, clinical, and translational research will be discussed. Issues related to bioinformatics, clinical, bioimaging and public health/population informatics will be explored.

**Prerequisite(s):** Class standing of senior or above.

**BMI 8300 PUBLIC HEALTH GENOMICS (3 credits)**

This course will address the biopsychosocial issues that bridge genomics and public health, which are generally considered two vastly different disciplines. The focus will center on understanding how genomics may be incorporated into health promotion and disease prevention efforts for individuals and population.

**Prerequisite(s):** Class standing of senior or above.

**BMI 8310 ADVANCED HEALTH INFORMATICS (3 credits)**

The purpose of this course is to equip students with advanced skills in analyzing healthcare data using state-of-the-art frameworks, tools, and applications. Students will learn to effectively use medical and health data, interpret results from analyzing this data, and construct a cohesive story outlining their findings in a clinical environment. Upon completion of this course, students will be able to outline current trends in health informatics, summarize the legislative and ethical barriers present in the field, and recognize common standardizations used in health informatics. In addition, students will be able to apply state-of-the-art data analytics and visualization approaches to tackle health relevant problems, using real world data from the MIMIC IV dataset.

**Prerequisite(s):** BMI 8100 and ISQA 8156 or Permission of the instructor. Not open to non-degree graduate students.

**BMI 8320 CONSUMER HEALTH INFORMATION SYSTEMS (1 credit)**

Consumer health informatics as a field focuses on health informatics from the perspective of the consumer or patient, health literacy, and consumer education. Creative problem solving and fluency in this subdiscipline requires competence in information structures and processes that empower consumers to manage their own health. In this course, students will strategically review publicly available databases, datasets, and projects involved in consumer health. With this information in hand, students will design their own consumer health information system geared towards addressing a consumer or patient education and literacy challenge of their interest.

**BMI 8400 LINEAR ALGEBRA FOR ADVANCED COMPUTING AND AI (3 credits)**

Matrix Analysis and Linear Algebra are at the core of several important algorithms and techniques that are widely used in machine learning for data analytics, imaging informatics, and bioinformatics. The course will explore fundamental concepts of matrix analysis and linear algebra as they apply to machine learning, emphasizing applications over proofs. Students will have an opportunity to perform "pencil and paper" calculations as well as more sophisticated numerical computations using a programming language/statistical environment of their choice. Applications of linear algebra to machine learning in the context of imaging informatics and biomedicine will be covered in depth.

**Prerequisite(s):** Proficiency in programming and knowledge of calculus are required. Familiarity with concepts from biology is beneficial but not required.

**BMI 8540 FOUNDATIONS IN PROGRAMMING FOR BIOMEDICAL INFORMATICS (3 credits)**

Foundations in programming, software development, pipeline management, and version control are critical for developing a capable biomedical informatics workforce. This course will provide foundations in programming skills necessary for students with a limited computer science background to develop fluency and basic skills in the concepts of software development for biomedical informatics. Specific topics covered will include Unix/Linux shell programming, Python, databases, Applications Programming Interface (APIs), software versioning, and data management.

**Prerequisite(s):** Experience with programming in a scripting, database management, or object-oriented programming language is strongly recommended but not required.

**BMI 8850 BIOMEDICINE FOR THE NONMEDICAL PROFESSIONAL (3 credits)**

This course will cover the basic principles of molecular and cellular biology, human anatomy, physiology, and pathology that are essential to an informed use of biomedical data. The biomedical topics will be interspersed and complemented with discussions about relevant data sources and datasets, emphasizing their strengths and weaknesses, and the lectures will be enriched with virtual anatomical dissections. Reading assignments from the primary literature and multimedia materials will supplement the textbook.

**Prerequisite(s):** Class standing of senior or above

**BMI 8866 BIOINFORMATICS ALGORITHMS (3 credits)**

The main objective of this course is to provide an organized forum for students to understand the foundations of algorithmic design and analysis in the context of health and biological data. The course will present fundamental concepts in algorithms (exhaustive, greedy, graph, heuristic, and more) and explore how those concepts extend to bioinformatics and related fields, such as biomedical informatics, and health informatics. Students will learn about historical context of these algorithms and how they were pivotal in forming more complex modern approaches, and will explore advanced algorithms in their area of interest. Students will also exercise their programming skills with the opportunity to implement and apply bioinformatics algorithms to real data, so to better grasp the technical components of algorithmic design and analysis. (Cross-listed with BIOI 4860).

**BMI 8896 COMPUTERIZED GENETIC SEQUENCE ANALYSIS (3 credits)**

The goal of this course is to introduce students to major topics in computerized analysis of genetic sequences. In particular the course will allow students to become familiar with the computational tools and software that aid in the modern molecular biology experiments and analysis of experimental results. Following the completion of this course, it is expected that the students will have a basic understanding of the theoretical foundations of the sequence analysis tools and develop competence in evaluating the output from these tools in a biological context. This course will emphasize hands-on experience with the programs for nucleotide and amino acid sequence analysis and molecular phylogeny. (Cross-listed with BIOI 4890).

**Prerequisite(s):** Permission from the instructor.

**BMI 8900 INDEPENDENT RESEARCH IN BIOMEDICAL INFORMATICS (1-3 credits)**

The content of the course will vary, however both the student and the faculty member must sign an Independent Research Agreement and file it with the Biomedical Informatics Graduate Program Committee before registration for the course. This agreement will detail the project, the schedule for its completion, the form of the output, the method of evaluation and other relevant information pertaining to the project.

**Prerequisite(s):** Permission of instructor, and at least 12 hours of course work toward the MS BMI program should be completed.

**BMI 8910 INTERNSHIP (1-3 credits)**

The purpose of this course is to provide the students with an opportunity for practical application and further development of knowledge and skills acquired in the Biomedical Informatics graduate program. The internship gives students professional work experience and exposure to the challenges and opportunities faced by IT professionals in the workplace.

**Prerequisite(s):** Students must have completed a minimum of 12 credit hours towards the MS in BMI program. Not open to non-degree graduate students.

**BMI 8950 BIOMEDICAL INFORMATICS GRADUATE CAPSTONE (3 credits)**

The graduate capstone course challenges students to prove their mastery of the skills and domain knowledge they have gathered throughout their program of study. The course begins with a module on project management and research best practices. The majority of the course is structured around facilitating a non-trivial semester-long project, often in service to a third-party project sponsor, such as a community, industry, or government partner. The course is intended for students that have selected the coursework option, not thesis, and that are close to graduation.

**Prerequisite(s):** Students must have 9 credit hours or fewer left in the program, including this course. Students must have completed all core courses, and core electives are recommended but not required. Not open to non-degree graduate students.

**BMI 8970 INDEPENDENT STUDY IN BIOINFORMATICS (1-3 credits)**

This is a variable-credit course designed for graduate students in bioinformatics who would benefit from independent reading assignments and research-type problems. Independent study enables coverage of topics not taught in scheduled course offerings.

**Prerequisite(s):** Permission of a supervising faculty member and approval of the Bioinformatics Program Committee Chair. A formal description of the problem area to be investigated, the resources to be used, and the results to be produced must be prepared.

**BMI 8990 THESIS IN BIOMEDICAL INFORMATICS (1-6 credits)**

A research project, designed and executed under the supervision of the chair and approval by members of the graduate student's thesis advisory committee. In this project the student will develop and perfect a number of skills including the ability to design, conduct, analyze and report the results in writing (i.e., thesis) of an original, independent scientific investigation.

**Prerequisite(s):** Graduate major in BMI and approval of the Thesis Advisory Committee. Not open to non-degree graduate students.

**BMI 9900 ADVANCED RESEARCH IN BIOMEDICAL INFORMATICS (3 credits)**

This course provides a format for exploring advanced research areas for doctoral students in Biomedical Informatics and related fields. Specific topics will vary in keeping with research interest of faculty and students.

**Prerequisite(s):** Admission to graduate program in Biomedical Informatics. Not open to non-degree graduate students.

**BMI 9980 INDEPENDENT RESEARCH IN BIOMEDICAL INFORMATICS (1-3 credits)**

This course allows students to research a topic of their interest that is not available in a formal course. The topic to be studied must be agreed upon by the student and the instructor.

**Prerequisite(s):** Admission to Ph.D. program in Biomedical Informatics and permission of instructor. Not open to non-degree graduate students.

**BMI 9990 DISSERTATION (1-12 credits)**

The dissertation is an original research project conducted and written under the direction of a faculty dissertation committee supervisory committee. The dissertation provides the student with an opportunity to do original research that contributes to advancing the body of knowledge in health or bioinformatics and demonstrate technical mastery of the discipline.

**Prerequisite(s):** Admission to the Ph.D. program in Biomedical Informatics and candidacy for the Ph.D. degree. Prior to enrolling for dissertation hours, the students must have permission of the supervisory committee. Not open to non-degree graduate students.



**BSAD 8000 BUSINESS ETHICS: ACHIEVING SOCIAL RESPONSIBILITY (2 credits)**

This core MBA course will explore the relationship between law and ethics, will examine the generally-accepted theoretical principles associated with doing business ethically, and will examine practical ethical issues associated with various facets of business.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent) or admission to the MAcc program. Students with an undergraduate major or a graduate degree in Law may not include this course in a plan of study for the MBA degree. Not open to non-degree students

**BSAD 8026 RESEARCH METHODS IN ECONOMICS AND BUSINESS (3 credits)**

Covers the methodology of economics: choosing a research topic, literature search tools, data source identification, data summary techniques, basic statistical data analysis using statistical packages, and clear economics writing. The student will become familiar with these techniques through text materials, journal studies, and completion of an empirical economics paper.

**Prerequisite(s):** Graduate standing. Not open to nondegree students.

**BSAD 8030 INFORMATION TECHNOLOGY IN BUSINESS (3 credits)**

The premise of this course is that today's managers must learn to use information technology to create competitive firms, manage global corporations and provide useful products and services to customers. Accordingly, the content of this course is focused on use of information technology for competitive advantage. Students will develop case studies of firms who have achieved this objective. Furthermore, the course will address emerging technologies and their current and potential application.

**Prerequisite(s):** Completion of MBA foundation courses and BSAD 8060 (prior to or concurrent). Not open to nondegree students.

**BSAD 8040 BUSINESS AND INFORMATION TECHNOLOGY: CONNECTING PEOPLE AND INFORMATION (2 credits)**

The premise of this course is that today's managers must learn to use information technology to create competitive firms, manage global corporations and provide useful products and services to customers. Accordingly, the content of this course is focused on use of information technology for competitive advantage. Students will develop case studies of firms who have achieved this objective. Furthermore, the course will address emerging technologies and their current and potential application.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in management information systems may not include this course in a plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8060 PEOPLE: CULTIVATING SKILLS FOR LEADERSHIP (2 credits)**

This course will prepare students with the skills to effectively enact the critical leadership skills of listening, employee feedback and coaching, goal-setting, empowerment/delegation, influencing, interviewing, conflict, negotiation, intercultural awareness, team/group discussions, and business etiquette.

**Prerequisite(s):** Admission to the MBA program. Not open to non-degree graduate students.

**BSAD 8066 HEALTHCARE ANALYTICS FOR BUSINESS (3 credits)**

This course will focus on the mixing of analytics and technology to develop key performance indicators that integrate and evaluate clinical, administrative, and financial performance. Concepts in this course explore the intersection of information management, performance metrics, data visualization, and result communication spanning across the healthcare ecosystem. Topics covering health outcome analysis, financial performance, developing analytic strategies, data quality and governance, and the four stages of actionable intelligence are all used to educate the advantages of leveraging analytics. (Cross-listed with MGMT 4060, SCMT 4060).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8070 COACHING & DEVELOPING OTHERS (2 credits)**

Organizational leaders must effectively coach and develop others in order to ensure sustainable long-term organizational performance. Both through one-on-one feedback and coaching as well as through strategy-aligned organizational-level talent development programs, leaders establish the organization's culture of employee development and growth.

**Prerequisite(s):** Admission to Executive MBA Program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8076 INTERNATIONAL LOGISTICS MANAGEMENT (3 credits)**

This course will focus on the logistics of international trade and how managers facilitate the flow of goods and services in import and export environments. Students will learn about infrastructure and business practices needed to manage international transportation, communications, services, and regulatory requirements. Students will develop an understanding of international terms of trade, transaction risk management, and location decisions for placement of warehouses and distribution centers. (Cross-listed with SCMT 4070).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8080 BUSINESS FORECASTING (3 credits)**

The course will cover forecasting tools and applications applied to business settings. The first half of the course will cover traditional Econometric forecasting methods and the second half of the course will focus on predictive analytics models and machine learning. Time in the computer lab will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with ECON 8310).

**Prerequisite(s):** ECON 8320 (or equivalent programming experience) or permission of instructor. Not open to non-degree graduate students.

**BSAD 8090 ESSENTIAL LEADERSHIP SKILLS (3 credits)**

This course will teach students the interpersonal skills necessary to effectively manage others. Second, this course will serve as a vehicle to assess the business content knowledge and computer literacy of incoming MBA students in order to provide customized remediation recommendations for each student. Third, the course will collect information that will be used for assessment and accreditation purposes to evaluate the effectiveness of the MBA program. This course will address the following MBA program themes: communication, change agent, teamwork, information technology, critical thinking and information gathering and analysis.

**Prerequisite(s):** Admission to the MBA program and completion of MBA foundation courses (or equivalent) or may be taken concurrently with the final foundation course. Not open to nondegree students.

**BSAD 8096 MANAGING COLLABORATIVE ENGAGEMENT (3 credits)**

This course will provide students with the opportunity to develop knowledge and strategies for leading teams, enhancing collaboration, building consensus, problem solving in teams, facilitating group processes, and designing collaborative workspaces. (Cross-listed with MGMT 4090, ACMP 4090, SCMT 4090)

**Prerequisite(s):** Admission to a graduate program at UNO or the STRATCOM Leader Fellow Program. Not open to non-degree students.

**BSAD 8100 MANAGERIAL ECONOMICS (3 credits)**

The course will offer students tools of analysis drawn from consumer theory and the theory of the firm in order to improve the understanding of human behavior as it is constrained in the context of business decision-making. This course is intended for students who are seeking the degree of Master of Science in Economics or the degree of Master of Business Administration.

**Prerequisite(s):** ECON 2200 and 2220 or BSAD 8180 and BSAD 8060. BSAD 8060 may be taken prior to or concurrent. Not open to nondegree students.

**BSAD 8110 ACCOUNTING AND FINANCIAL FUNDAMENTALS (3 credits)**

The course is designed to give incoming graduate students the foundation in accounting that is necessary for subsequent graduate courses. Emphasis is on introducing the students to as many accounting concepts as possible.

**Prerequisite(s):** Graduate admission or permission of the appropriate graduate advisor. This course cannot be used in a plan of study for any graduate program at UNO. Not open to non-degree graduate students.

**BSAD 8136 HUMAN RESOURCE MANAGEMENT (3 credits)**

This course is a comprehensive review of the field of human resource management and its relevance to employees, managers, and organization stakeholders for goal achievement. The design of this course is structured to educate future managers and leaders on the importance of utilizing effective HR methods that comply with federal laws and the critical role of HR professionals in achieving the organization's positive workplace culture, competitive advantage, and overall success. (Cross-listed with MGMT 4030).

**Prerequisite(s):** BSAD 8136 students do not have any prerequisite courses; however, BSAD 8250 (Organizational Behavior) is recommended prior to enrollment.

**BSAD 8140 BUSINESS INTELLIGENCE ANALYSIS (2 credits)**

In BSAD 8440 you learned how to extract and manipulate data in a business intelligence tool. In this class you will learn to use this data to extract business knowledge. To do this, you will learn about the data model, methods of aggregation, and visualizations in the business intelligence (BI) software.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8440. Not open to non-degree graduate students.

**BSAD 8146 TOTAL REWARDS (3 credits)**

This course is a comprehensive review of the theory and practice of developing and implementing cost-effective employee compensation and benefits programs. Students will gain and utilize effective strategies for managing the single largest controllable expense for organizations; employee pay and benefits. The design of this course is most beneficial for students pursuing future careers in management and human resource professions. (Cross-listed with MGMT 4010).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8150 ECONOMICS: ESSENTIAL CONCEPTS FOR MANAGERS (2 credits)**

This course exposes MBA students to fundamental economic concepts necessary for successful business planning and financial success. Topics include: Comparative advantage and international trade, market dynamics, the role that the competitive landscape plays in company decision-making, macroeconomic growth and development, and monetary and fiscal policy and their impact on business activity.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in economics may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8156 TALENT DEVELOPMENT (3 credits)**

This course is a comprehensive review of the theory and practice of developing and implementing cost-effective employee training and development programs to optimize human capital effectiveness in modern organizations. The course is designed to enable future managers and human resource professionals to utilize effective strategies for assessing employee training needs and developing appropriate solutions to maximize talent utilization. (Cross-listed with MGMT 4120).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8160 INTERMEDIATE ANALYTICS (2 credits)**

Business Intelligence software tools are statistical in nature. Many of the visualizations/widgets use statistics "under the hood" to provide insights to you the user. Can you trust these insights? How are they calculated? When are they appropriate? In this class, you will learn the answers to these questions.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8140. Not open to non-degree graduate students.

**BSAD 8166 STAFFING THE ORGANIZATION (3 credits)**

This course is a comprehensive review of issues and techniques involved in the acquisition and management of a high quality and diverse workforce for optimal organizational effectiveness. Students pursuing future manager and human resource professions will benefit from practice utilizing effective strategies for recruiting, selecting, placing, and integrating new employees into an organization's workforce. (Cross-listed with MGMT 4110).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8176 EMERGING TRENDS IN SUPPLY CHAIN MANAGEMENT (3 credits)**

This course will focus on megatrends influencing supply chain management and design in the 21st century. Key concepts in this course will include contemporary opportunities and challenges in creating customer value via the supply chain with a focus on globalization, sustainability, and risk management. Specific topics will include the influence of the empowered customer on supply chain design, global supply chain trends, and the need for integration of technology and talent to create a competitive advantage. (Cross-listed with SCMT 4170).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8190 APPLICATIONS IN ANALYTICS (2 credits)**

What is a 'business question' and how do you answer it with data? In this class you will learn to form testable business questions. This course will build on the knowledge you gained in BSAD 8440, BSAD 8140, and BSAD 8160 to answer your business questions with the help of business intelligence software.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8160. Not open to non-degree graduate students.

**BSAD 8200 MANAGERIAL ACCOUNTING (3 credits)**

A study of concepts, analysis and procedures of accounting utilizing internal financial and non-financial data which provides management with information for planning and controlling routine operations, for non-routine decisions, policy-making and long-range planning; and for external reporting to stockholders, governments and interested parties.

**Prerequisite(s):** ACCT 2010 and 2020 or BSAD 8110, and BSAD 8060. BSAD 8060 may be taken prior to or concurrent. Not open to nondegree students.

**BSAD 8206 CONSULTATIVE SELLING PRINCIPLES (3 credits)**

The primary focus of the Consultative Selling Principles course is to develop the behaviors, methodologies, principles, and processes required to successfully lead and manage complex selling initiatives to a win-win close. The course examines and applies, through role playing and other activities, the critical relationship building, critical thinking, problem solving, listening and negotiating capabilities which are the foundation skills underlying consultative selling. (Cross-listed with MKT 4200)

**Prerequisite(s):** MKT 3310 with 'C+' or better; MKT 3100 with C+ or better; GPA of 2.5 or better; or permission of instructor. Not open to non-degree graduate students.

**BSAD 8210 ACCOUNTING: DECISIONS & CONSEQUENCES (2 credits)**

Managers and administrators must be able to understand, analyze, and use accounting information to make operational and strategic business decisions. In this course, we will study practical uses of accounting information to address the problems and decisions managers face in business. Emphasis is placed on the user of accounting information rather than the preparer. Upon completion of this course, a student should be able to use accounting information to make management decisions, understand how accounting rules inform those decisions, and consequently, how those decisions affect a company's financial reports.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or graduate degree in accounting may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8216 SELLING FINANCIAL SERVICES (3 credits)**

Selling Financial Services concentrates on methods to effectively sell services and products in the financial services industry, including the banking, brokerage and insurance sectors. Targeting, initiating, and acquiring client relationships, expanding business opportunities, and maintaining long-term client relationships are the course's focal points. This integrative course is designed to provide students with a basic understanding of the selling profession and sales culture within the financial services industry. (Cross-listed with MKT 4210, FNBK 4210).

**Prerequisite(s):** Not open to non-degree graduate students.

**BSAD 8220 ADVANCED APPLICATIONS IN ANALYTICS (2 credits)**

Using the knowledge gained in BSAD 8440, BSAD 8140, BSAD 8160, and BSAD 8190, each student in this course will work individually to apply the entire business analytics process (starting with data collection and ending with using results to make informed decisions) to a real problem in their own organization.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8190. Not open to non-degree graduate students.

**BSAD 8226 GLOBAL STRATEGIC ACCOUNT MANAGEMENT (3 credits)**

Throughout this course, the management of strategic account programs at national, multi-country, and global levels will be addressed. The primary focus of the curriculum is on the critical success factors for driving revenue, sustainable long term-growth and profitability with a base of core strategic buyers.

**Prerequisite(s):** Senior or graduate student standing and permission of the instructor. Not open to non-degree graduate students.

**BSAD 8230 LEADING CHANGE & INNOVATION (2 credits)**

This course focuses on providing leaders with the knowledge and ability to lead organizational change and enhance organizational innovation. Topics include organizational culture, organizational design, and organizational processes (including reward systems).

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8236 GLOBAL BUSINESS MANAGEMENT (3 credits)**

The central objective of this course is to explore the unique opportunities and challenges that confront international managers as they navigate the complex and ever-changing global economic, political, legal, technological, and cultural environment. This course will particularly focus on people, values, and culture, better equipping students to both undertake an international career as well as effectively lead organizations with a culturally diverse workforce in any environment. (Cross-listed with MGMT 4150).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8240 EFFECTIVE LEADERSHIP OF PEOPLE (2 credits)**

This course aims to enhance the leadership effectiveness of students by developing knowledge of what constitutes effective leadership and how to apply leadership concepts and models.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8250 ORGANIZATIONAL BEHAVIOR: ENHANCING HUMAN & ORGANIZATIONAL CAPABILITIES (2 credits)**

This course will prepare students with the knowledge necessary to manage and lead organizations effectively. Students will learn management theories, understand important research findings in organizational behavior, and apply both theory and research results to real organizational situations, thus giving them the capacity to use OB theories to enhance organizational effectiveness.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in management may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8260 EFFECTIVE USE & REPORTING OF ACCOUNTING INFORMATION (2 credits)**

This course focuses on the use and reporting of accounting information, with an emphasis on financial statements and how executive decisions can influence these statements. Financial statements, including footnotes and explanatory material, are the primary instruments utilized by parties external to the enterprise in making judgments about the enterprise. By understanding how management decisions are reflected in the financial statements, managers will understand how they can influence their judgment.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8280 EMPLOYEE RECRUITMENT, ENGAGEMENT, AND RETENTION (2 credits)**

Effective recruitment, engagement, and retention of highly motivated and high performing employees is critical for organizational success. This course will address the key organizational characteristics that must be in place for this to occur.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership.

**BSAD 8300 ORGANIZATION THEORY & DESIGN (3 credits)**

This course is designed to increase students' understanding and knowledge of how organizations are designed and structured in order to create value and competitive advantage, and how organizations can operate in an effective and efficient manner in an ever-changing environment. The course will address topics such as: organizational effectiveness, organizational structure, organizational design, organizational culture, organizational technology, the external environment, organizational change, and the organizational life cycle. The ultimate goal is for students to be able to understand how organizations should be structured as a result of both external and internal factors.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8310 MANAGING PERFORMANCE IN ORGANIZATIONS (3 credits)**

A human behavior course emphasizing the areas of individual behavior, interpersonal behavior, group behavior and the interplay of human and non-human factors.

**Prerequisite(s):** Essential Leadership Skills (BSAD 8060) or admission to the MAcc program. Not open to nondegree students.

**BSAD 8326 SALES MANAGEMENT (3 credits)**

The student will be exposed to current research findings in sales management and to business cases and simulations where sales management theories and concepts will be applied. This course will prepare students to develop and implement specific compensation, motivation, and evaluation strategies for managing sales professionals across a wide variety of organizations. (Cross-listed with MKT 4320.)

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8330 LEADING TEAMS (2 credits)**

This course focuses on building and leading high-performing teams in organizations. Topics include how to evaluate team effectiveness, how to create and develop teams that are cohesive and high-performing, how to lead and facilitate teams, and how to diagnose and intervene when teams are experiencing problems.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8336 PROJECT MANAGEMENT (3 credits)**

This course focuses on the systemic exploration of planning and executing complex projects to create organizational success. Using a comprehensive understanding of principles, methodologies, and tools within project management, students will learn how to initiate critical processes, plan objectives and constraints, execute management and leadership, monitor budgets and development, and close outcomes of complex projects. Skills obtained from this course enhance individuals' ability to recognize, identify, and prioritize organizations' culture and structure to lead projects across various industries efficiently. (Cross-listed with MGMT 4330, SCMT 4330)

**Prerequisite(s):** Admission to Graduate College, MBA Program; or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8340 INTERNATIONAL BUSINESS STUDY ABROAD (3 credits)**

This course provides students with an international business and cultural experience through a study tour in a selected international location. Students will develop an understanding of the factors that affect international business decisions by visiting American companies operating abroad and foreign companies that export goods and services to the U.S.

**Prerequisite(s):** Instructor Permission.

**BSAD 8345 CONSUMER BEHAVIOR (3 credits)**

Consumers purchase, use, experience, and dispose of products and services as part of their consumption process. How and why consumers choose various brand options, form judgments about these brands, and decide which options to buy and/or re-buy are essential knowledge for marketing professionals. The course covers the psychological and social issues that guide consumption decisions. (Cross-listed with MKT 3320).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor.

**BSAD 8356 GLOBAL SOURCING AND INNOVATION (3 credits)**

This course focuses on global suppliers as partners in the development and commercialization of new products. Students will learn about open innovation and the integration of internal and external business systems in new product innovation. Students will develop an understanding of regulatory policies related to information sharing and the intellectual property rights of buyers and suppliers. (Cross-listed with SCMT 4350).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8360 EFFECTIVE MANAGEMENT OF CAPITAL STRUCTURE, CASH, & RISK (2 credits)**

Students will develop strategic decision making skills by using financial concepts including time value of money, capital budgeting processes, cash flow forecasting and project risk analysis. Topics covered include: capital budgeting, financial statement analysis, capital structure, financial risk analysis.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8366 E-MARKETING (3 credits)**

This course focuses on utilizing the Internet as a marketing platform. Course content includes discussion of how the Internet is used by businesses for designing products, pricing, promotions, distribution, positioning, gathering information, and cultivating relationships with stakeholders. The discussion about the rise of social media, sharing economy, virtual reality devices, and other relevant trends will also be part of the course. (Cross-listed with MKT 4360).

**Prerequisite(s):** BSAD 8400 with a grade of 'B' or above. Not open to non-degree graduate students.

**BSAD 8370 LEADERSHIP IN DIVERSITY, EQUITY, ACCESS, AND INCLUSION (2 credits)**

This course will focus on the role that organizational leaders play in proactively addressing organizational issues related to diversity, power, access, and equity. The course will explore tensions through the range of dimensions in which diversity is manifested among business leaders, staff, and stakeholders (which includes anyone impacted by the organization's business decisions - e.g., employees, contractors, suppliers, customers, and the community). Policies, systems, histories, structures, and legislation will also be discussed.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8376 SUPPLY CHAIN ANALYTICS (3 credits)**

This course focuses on integrating supply chain management through the use of key performance indicators. Key concepts in this course include data visualization, supplier performance metrics, service-dominant logic, and the supply chain for data. Specific topics include the influence of the empowered customer on supply chain metrics, using metrics to develop a competitive advantage, data-driven decision making, and the four stages of actionable intelligence. (Cross-listed with SCMT 4370).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8380 EFFECTIVE SYSTEMS, OPERATIONS, AND IT (2 credits)**

Students will learn how to employ decision-making skills to create a long-term competitive advantage for an organization through operational and technical excellence. Key concepts in this course will include developing a view of organizations as technical and behavioral systems, operations management, quality management, strategies related to IT procurement, deployment, maintenance and security, and the supply chain. Specific topics will include applied systems theory, process improvement, quality assurance, supply chain management, IT systems development strategies, and issues related to systems security, data security, and data privacy.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business

**BSAD 8386 INDUSTRIAL PURCHASING AND LOGISTICS MANAGEMENT (3 credits)**

This course will focus on the strategic procurement of products and services in order to gain a competitive advantage through integrated supply management. Students will learn about strategic supply management, contract negotiation, and supplier quality management. Students will develop an understanding of supplier performance management through the use of supply chain information systems. (Cross-listed with MKT 4380, SCMT 4380)

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.



**BSAD 8396 MARKETING ANALYTICS (3 credits)**

This course focuses on the application of data analytics in marketing decision making (e.g., segmentation, sales forecasting, and resource allocation). Students will learn to apply statistics and econometrics to solve marketing problems. Key topics in this course include marketing data visualization, marketing metrics, descriptive and predictive analytics, and digital marketing analytics. This course takes a very hands-on approach with real-world databases and equips students with tools that can be used immediately on the job. (Cross-listed with MKT 4370).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8400 MARKETING POLICIES (3 credits)**

This course provides an introduction to the fundamental concepts of marketing, including a customer orientation, matched with attention to competition and core strengths. The course will illustrate strategies and principles that will help you understand how marketing managers, product managers or service managers must think through their situations, determine their goals and lay a course to achieve those goals.

**Prerequisite(s):** Completion of MBA foundation courses and BSAD 8060 (prior to or concurrent); or admission to MAcc program. Not open to nondegree students.

**BSAD 8416 DIVERSITY, EQUITY, ACCESS AND INCLUSION SOLUTIONS FOR MINIMIZING RISK (3 credits)**

This course provides students an opportunity to explore the various aspects of power, access, and equity as it relates to the business environment. Students will explore tensions through the range of dimensions in which diversity is manifested among business leaders, staff, and stakeholders (include anyone impacted by business decisions, such as: employees, contractors, suppliers, customers, and the community) through policies, systems, histories, structures, and legislation. Students will have the opportunity to learn differences that individuals bring to a business environment and how stakeholders can capitalize on those differences by creating long-term inclusive environments. (Cross-listed with LAWS 4410).

**Prerequisite(s):** Admission to the MBA program. Not open to non-degree graduate students.

**BSAD 8420 MARKETING: UNDERSTANDING CONSUMERS AND MARKETS (2 credits)**

This course exposes MBA students to the fundamental concepts, practices and issues of marketing. A wide range of marketing practices and structures will be explored including product and service firms, consumer and business markets, profit and not-for-profit organizations, domestic and global companies, and small and large businesses.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in marketing may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8426 BUSINESS DEMOGRAPHICS (3 credits)**

The goal of this course is to develop a demographic perspective in order to assist in understanding the business environment and business policy. How population change impacts consumer markets and all of the functions (for example, accounting, finance and management) that must exist for these markets to perform. Includes a history of population change and policy as well as a view toward international population considerations. (Cross-listed with MKT 4420).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8430 STRATEGIC BRAND MANAGEMENT (3 credits)**

An exploration of the characteristics, meanings, and management of brands in the business world. The course examines brands as a strategic asset, and draws on managerial, consumer, and cultural perspectives.

**Prerequisite(s):** BSAD 8420 or permission of instructor. Not open to nondegree students.

**BSAD 8435 MARKETING INNOVATION (3 credits)**

Product, service, and process innovation are essential drivers of firm performance. However, firms face considerable and complex challenges when bringing innovative ideas to life. For example, what marketing research methods should we employ to uncover vital consumer insights? How do these insights influence the development and launch of new products and services? What differentiated value are we delivering to our consumers? How do we successfully bring this new product or service to market? How does a brand's purpose and personality influence consumers' perceptions, purchase decisions, adoption, and engagement? This course will cover key marketing principles involved in the development and launch of new and innovative products and services - from conception to commercialization. Furthermore, we will explore how new-age technologies impact each stage of the development and launch processes. (Cross-listed with MKT 3400).

**Prerequisite(s):** BSAD 8420 or equivalent; and admission to Graduate College, MBA Program or by permission of the instructor.

**BSAD 8440 BUSINESS INTELLIGENCE DATA EXPLORATION (2 credits)**

The first in any analytics project is to get data ready for analysis. In this class you will learn to extract data from a business data source and ready it for analysis in a business intelligence software tool. In the process you will learn tools necessary for this process including SQL, Power Query, M, and DAX.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics. Not open to non-degree graduate students.

**BSAD 8450 SEMINAR IN MARKETING (3 credits)**

Exploration, study and critical analysis of contemporary marketing problems, trends, methods and approaches for seminar discussion and written report.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8456 MANAGERIAL NEGOTIATION STRATEGIES (3 credits)**

This course introduces students to the theory and practice of negotiation across various organizational settings. The ability to successfully negotiate an outcome is an important aspect of management and leadership. Negotiation can be used to determine multiparty relationships, manage conflict resolution, and improve organizational outcomes. Using a combination of conceptual frameworks, roleplaying exercises, and debriefing opportunities, the design of this course is structured to help students understand the power and influence negotiation has over the successful outcomes of managers, leaders, and organizations. (Cross-listed with MGMT 4450, SCMT 4450).

**Prerequisite(s):** Admission to Graduate College, MBA Program, or by permission of the instructor.

**BSAD 8476 BEHAVIORAL FINANCE & INVESTING (3 credits)**

This course focuses on how actual investor behaviors and market behaviors differ from traditional theories of finance. This course will examine psychological biases, identify how such biases influence financial markets and settings, and explore methods that can be utilized to recognize and overcome such behavioral pitfalls. (Cross-listed with FNBK 4470).

**Prerequisite(s):** Admission to graduate college, MBA program, or by permission of instructor. Not open to non-degree graduate students.

**BSAD 8480 GLOBAL ECONOMICS AND CORPORATE SOCIAL RESPONSIBILITY (2 credits)**

In this course students will learn both how to apply global economic issues business strategy and how to balance socially responsible activities with the profit motive. With respect to global economics, topics include gains from trade, international trade patterns, foreign exchange markets, and barriers to trade. With respect to corporate social responsibility, topics include social responsibility and working conditions, socially responsible stewardship of the environment, and socially responsible strategies concerning human rights issues.

**Prerequisite(s):** Admittance to the Executive MBA Program or the Executive Certificate in Business.

**BSAD 8510 SECURITY ANALYSIS (3 credits)**

Study of the efficient market, fundamental and technical analysis approaches for the valuation of marketable securities. Methods of analysis are considered for the economy, industry groups and individual corporations.

**BSAD 8520 SEMINAR INVESTMENT MANAGEMENT (3 credits)**

This course focuses upon the modern portfolio theory of investment management and its application in formulation of policies for individuals and institutional investors. Topics addressed will include qualitative and quantitative analysis of the risks and returns of portfolio management using efficient market, fundamental analysis, and technical analysis approaches.

**Prerequisite(s):** BSAD 8510. Not open to nondegree students.

**BSAD 8530 BANK & FINANCIAL MARKETS (3 credits)**

This course focuses on the theory and practice in managing commercial banks. Topics covered include but not limited to: bank regulations, bank performance analysis, asset liability management, credit analysis and consumer loans. The course emphasizes the link between theory and practice through assigned course related readings, guest lecturers from industry experts, and a comprehensive bank research project on a local bank of your choice. At the end of the course, students should have a good understanding of basic banking theories as well as banking practices, and current issues and challenges facing the banking industry.

**Prerequisite(s):** BSAD 8500. Not open to non-degree graduate students.

**BSAD 8540 MULTINATIONAL FINANCIAL MANAGEMENT (3 credits)**

The focus of this course is on multinational financial management as viewed and practiced by the multinational firm and on current developments in international financial markets, including global banking. Familiarity with certain areas of the firm's environment, such as the international monetary system, the European Monetary System, and determination of exchange rates under alternative regimes, is essential to the international financial manager.

**BSAD 8550 SEMINAR IN FINANCE (3 credits)**

This course will address specific financial management topics which will vary by semester and is intended for graduate students.

**BSAD 8560 MARKETING STRATEGY: CUSTOMERS AND MARKETS (2 credits)**

This course will focus on how successful businesses match their objectives and resources with opportunities in the marketplace by identifying and measuring consumer needs, determining target markets and deciding which products and services to offer. This course will also address pricing, promotion, and distribution strategies to create competitive advantage in domestic and international markets.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8570 EFFECTIVE STRATEGIC MANAGEMENT (2 credits)**

This course centers around the theme that a company achieves sustained success if and only if its managers (1) develop, and revise as needed, an action-oriented strategic plan and (2) implement and execute the plan with some proficiency. Students will develop the strategic thinking skills needed to formulate and execute successful strategies for firms/organizations in a variety of industries and dynamic environments. Emphasis is given to the contributions of several business disciplines of study, such as marketing, finance and management, to understanding both the internal operations of the organization and the influences of the external environment. This course is integrative and introduces both the theory and practice that enables that integrative process.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8576 INVESTMENT MANAGEMENT FOR FINANCIAL ANALYSTS (3 credits)**

This course provides critical knowledge needed for students pursuing a career in investment management. The topic areas bridge academic theory, current industry practice, and ethical and professional standards and comprehensively address the areas assessed in the Chartered Financial Analyst examinations. (Cross-listed with FNBK 4570)

**Prerequisite(s):** Graduate standing. Not open to non-degree graduate students.

**BSAD 8590 EXECUTIVE MBA CAPSTONE PROJECT (4 credits)**

Students in the Executive MBA capstone project course will complete an applied consulting project for an organization that requires them to integrate knowledge across multiple Executive MBA program knowledge areas. Students will identify the key problem(s) to be solved, use sound methodologies to gather necessary data, identify and employ relevant evidence-based research and practitioner literatures, apply relevant models and theories to guide the generation of potential solutions and implementation strategies, and identify the feasibility and financial implications of their proposed solution(s).

**Prerequisite(s):** Admission to the Executive MBA Program. Not open to non-degree graduate students.

**BSAD 8596 RISK MANAGEMENT FOR BUSINESS MANAGERS (3 credits)**

An analysis of risk management techniques for handling the risk exposures most businesses face, including insurance, self insurance, risk control, and risk avoidance, among others. (Cross-listed with FNBK 4590.)

**BSAD 8600 REAL ESTATE FINANCE THEORY AND APPLICATIONS (3 credits)**

This course explores advanced financial analysis tools and methodologies used to quantify complex factors surrounding real estate productivity, value, investment, and project feasibility. Specific course topics will coincide with student interest in one of three focus areas: Investment, Development, or Commercial Finance.

**Prerequisite(s):** RELU 3410 and BSAD 8630, or permission of Real Estate Program Director.

**BSAD 8605 REAL ESTATE PRINCIPLES AND PRACTICES (3 credits)**

This is a survey course in real estate principles and practices, which is designed to familiarize students with industry terminology, current practices, and cover the following topics: Licensure, property rights, legal descriptions, real estate law and contracts, appraisal, financing, investments, Fair Housing, and related topic areas. This course provides foundational knowledge of the real estate field and will prepare students to successfully complete more advanced real estate coursework. NOTE: Students cannot receive credit for both RELU 2410 and RELU 3410. (Cross-listed with RELU 3410).

**Prerequisite(s):** Admission to Graduate College, MBA Program, or permission of Real Estate Program Director.

**BSAD 8606 FINANCIAL RISK MANAGEMENT (3 credits)**

The course provides students with an intermediate level analysis of financial derivatives, and the use of these instruments for managing risk in financial institutions. (Cross-listed with FNBK 4600.)

**Prerequisite(s):** BSAD 8500 and 8510 or their equivalent, and graduate standing. Not open to nondegree students.

**BSAD 8610 REAL ESTATE APPRAISAL (3 credits)**

This course addresses the fundamentals of real estate valuation and appraising, including factors affecting value, valuing land, improvements, and special classes of residential property, appraisal practice and rules, depreciation and obsolescence, and the mathematics of appraising.

**Prerequisite(s):** RELU 3410 and BSAD 8630, or permission of instructor.

**BSAD 8616 REAL ESTATE INVESTMENTS (3 credits)**

This course focuses on methods used to analyze existing and proposed commercial and residential real estate investments through dynamic programming models, and explores strategies to finance commercial real estate. The class ultimately prepares students to understand the risks and rewards associated with financing and investing in real estate. (Cross-listed with RELU 4390).

**Prerequisite(s):** RELU 2410 or RELU 3410 or FNBK 3250 or BSAD 8605 or BSAD 8630

**BSAD 8625 PROPERTY MANAGEMENT (3 credits)**

This course focuses on commercial and residential property management concepts and their application to the operation, control, and oversight of real property. The course will study leasing, tenant selection and relations, maintenance, marketing, contract management, asset management principles, as well as Fair Housing Laws and the Americans With Disabilities Act as they pertain to property management. (Cross-listed with RELU 3450).

**Prerequisite(s):** BSAD 8605, or permission of the Real Estate Program Director.

**BSAD 8626 REAL ESTATE DEVELOPMENT (3 credits)**

This course focuses on the procedures and complexities in developing and redeveloping various commercial property types and mixed-use real estate. Topics include an overview of the real estate development process, assembling a team, identifying project stakeholders, financial analysis, site selection, market analysis, and the regulatory environment. (Cross-listed with RELU 4440).

**Prerequisite(s):** BSAD 8605 or BSAD 8630, or permission of the Real Estate Program Director.

**BSAD 8630 FINANCE: UNDERSTANDING CAPITAL AND CASH (2 credits)**

As a comprehensive introduction to financial management, the course will cover various fields of finance and discuss topics including the time value of money, bond and stock valuation, capital budgeting.

**Prerequisite(s):** BSAD 8060 or BSAD 8070, 8150 and 8210. Students with an undergraduate major or a graduate degree in finance or accounting may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8640 IT: STRATEGIC DEVELOPMENT AND DEPLOYMENT (1 credit)**

Students will gain a strategic perspective of information technology management, including current trends and best practices, and understand how technology can be used in competitive positioning. Processes for innovation and research and development spending and new business models will be covered.

**BSAD 8650 VISION & STRATEGIC LEADERSHIP (2 credits)**

This course focuses on the critical role that organizational leaders play in ensuring that the organization has a clear vision and a clear mission which are in alignment with the organization's business strategy and unit goals and effectiveness metrics. This course focuses on the mission and vision creation and communication process as well as vertical and horizontal goal alignment.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8660 FRONTIERS OF ANALYTICS (2 credits)**

In this program, you have learned many analytics techniques. However, analytics is a constantly evolving field with increasingly advanced methods. What techniques might be presented to you as a manager? How do you interpret these results? In this class we will explore cutting-edge analytics methods and when they are appropriate for your business.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8160. Not open to non-degree graduate students.

**BSAD 8680 SUPPLY CHAIN INTEGRATION (3 credits)**

This course will focus on the integration of internal and external systems designed to maximize the efficiency and effectiveness of supply chain networks developed by industrial organizations, government agencies, and not-for-profit organizations. Key concepts will include supply chain design, trends in technology, and cross-functional collaboration, coordination, and communication along the value chain. Specific topics will include the influence of empowered customers on supply chain integration, global supply chain trends, closed-loop supply chains, and the challenges and benefits of integrating technology and talent in the workplace.

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8696 EMERGING TECHNOLOGY AND INNOVATION (3 credits)**

This course equips entrepreneurially-minded students with a more complete range and vision of the viability of various startup opportunities (with a specific focus on innovative technologies and innovative business models). Students will become familiarized with the new and emerging technologies and innovations that define modern industries and product categories, as well as the various shifts in the way cutting-edge business gets done, regardless of industry. (Cross-listed with ENTR 4690, MGMT 4690).

**Prerequisite(s):** Admission to a UNO graduate degree program or permission of instructor

**BSAD 8700 BUSINESS ANALYTICS: MAKING SENSE OF DATA (2 credits)**

The purpose of this course is to provide business managers with an understanding of the important role data analytics has assumed in today's organizations. Data analytics has become a key component in accomplishing strategic and operational goals. This course is designed to familiarize students with the concepts and principles of analytics. It is targeted for graduate or MBA students who have little or no background in analytics. Therefore, it focuses on breadth of coverage rather than depth in any specific area.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent); or admission to the MAcc program. Not open to non-degree graduate students.

**BSAD 8710 SUPPLY CHAIN MANAGEMENT (3 credits)**

This course will focus on supply chain management as a key functional area of organizational success. Students will learn about current techniques used by supply chain practitioners to make strategic and tactical decisions that support the overall strategy and day-to-day operations of an organization. Students will develop an understanding of how supply chain decisions and appropriate metrics of performance can be utilized to improve the operational efficiency and effectiveness of an organization.

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8720 STRATEGIC FINANCIAL MANAGEMENT (2 credits)**

This course is intended to be advanced financial management. It will stress the theory and application of topics including, but not limited to capital budgeting, cash flow estimation, real options, capital structure, dividends and share repurchases, working capital management, budgeting, planning and forecasting, and lease management. The material covered in Strategic Financial Management will increase the student's knowledge of how to strategically manage financial resources to increase the intrinsic value of the organization.

**Prerequisite(s):** For MBA students, BSAD 8630. For MAcc students, completion of all Master of Accounting (MAcc) foundation courses. Not open to non-degree graduate students.

**BSAD 8726 INNOVATION VENTURES (3 credits)**

This team-based course provides students with the opportunity to practice the basic tools of business discovery and validation. Concepts and techniques in innovation, entrepreneurship, and strategy will be used to aid students in the venture creation process. Important considerations impacting the viability of the venture post formation will also be explored. Practical real-world experimentation is the central component of the course and will help students to conceive, develop, and launch their own innovative ventures. (Cross-listed with ENTR 4720, ACMP 4720, ACMP 8256, MGMT 4720, MKT 4720).

**Prerequisite(s):** Admission to a graduate program or by instructor permission

**BSAD 8736 ECONOMICS OF ENTREPRENEURSHIP (3 credits)**

This course will review economic theories of entrepreneurship with special emphasis on Schumpeter's theory of creative destruction. The main focus of the seminar will be on the "high-level" entrepreneurship that sometimes results in major innovations. This course will address the societal benefits of entrepreneurship, factors influencing entrepreneurial success, the policies that best encourage entrepreneurship, and how firms can survive and prosper in an entrepreneurial environment. (Cross-listed with ECON 4730, ECON 8436)

**Prerequisite(s):** ECON 2200 or permission of the instructor for all students

**BSAD 8766 SELLING IN AN ENTREPRENEURIAL CONTEXT (3 credits)**

Successful entrepreneurs are able to identify unmet needs in the marketplace and then design and sell products or services that fulfill those needs. Sales effectiveness is essential for entrepreneurs because they must be able to build sustainable sales pipelines that ensure profitable growth while simultaneously addressing other pressing issues including financing, staffing, and product development. This course will focus on consultative solution-based sales fundamentals that can be applied in an entrepreneurial selling environment. (Cross-listed with ENTR 4760, MKT 4760)

**Prerequisite(s):** GPA 2.5 or better; MKT 3100 with a "C+" or better; MKT 3310 with a "C+" or better; or permission of instructor. Not open to non-degree graduate students.

**BSAD 8776 INTRODUCTORY MAVERICK VENTURE FUND (1 credit)**

This course teaches the basics of venture capital, including, the topics of term sheets, due diligence and learning the perspectives of the entrepreneur and investor. Students in this course have the opportunity to observe more advanced students making investments, ranging from 5,000 dollars to 10,000 dollars plus. This course is the first of three, one-credit courses where students gain more advanced venture funding knowledge and application at each level. (Cross-listed with ENTR 4770).

**Prerequisite(s):** This course requires instructor approval. Students must apply and interview to take this course. Preference is given to students in their junior year, and must have three semesters of school left before graduating.

**BSAD 8786 INTERMEDIATE MAVERICK VENTURE FUND (1 credit)**

In this course, students source deals, listen to pitches, and select start-ups to be funded. Investments typically range from 5,000 dollars to 10,000 dollars plus. This course is the second in a set of three courses that increase in difficulty with each course. (Cross-listed with ENTR 4780).

**Prerequisite(s):** This course requires instructor approval. Students must have completed BSAD 8776 with a grade of C or better.

**BSAD 8796 ADVANCED MAVERICK VENTURE FUND (1 credit)**

This course applies advanced concepts of venture capital. Students will learn how to monitor and assist start-ups in the scaling process. Students learn how to leverage community partners to amplify investment opportunities. This course is the third in a set of three courses that increase in difficulty with each course. (Cross-listed with ENTR 4790).

**Prerequisite(s):** This course requires instructor approval. Students must have completed BSAD 8786 with a grade of C or better.

**BSAD 8800 MBA PROJECT-FOCUSED CAPSTONE (2 credits)**

In this Master's of Business Administration (MBA) required project-focused capstone course, students complete a service-learning consulting project for a non-profit or other type of organization. This consulting project will focus on the application of the knowledge and skills learned in the MBA program.

**Prerequisite(s):** Students must successfully complete BSAD 8630, BSAD 8420, and BSAD 8830 prior to Capstone and must also complete this course in the final semester or within the last nine (9) hours of their MBA program. Not open to non-degree graduate students.

**BSAD 8820 CONTEMPORARY BUSINESS ISSUES (1 credit)**

This course exposes students to contemporary business issues that they are likely to experience as leaders. Students will examine and synthesize academic literature relevant to an instructor-approved specific topic associated with the contemporary business issue of focus. This course can be used for MBA students who need a one credit hour course to meet their credit hour graduation requirements.

**Prerequisite(s):** BSAD 8150 or permission of instructor. Not open to non-degree graduate students.

**BSAD 8830 STRATEGY: DEVELOPING SUSTAINABLE COMPETITIVE ADVANTAGE (2 credits)**

This course centers on the theme that a company achieves sustained success if and only if its managers (1) develop, and revise as needed, an action-oriented strategic plan and (2) implement and execute the plan with some proficiency. The primary objective of this course is to sharpen the ability of students to think strategically, to diagnose situations from a strategic perspective and to develop creative solutions to enable firms to achieve a sustainable competitive advantage.

**Prerequisite(s):** Students must successfully complete BSAD 8150 and BSAD 8210 before enrolling in this course. This course must be taken within the first 20 hours of the MBA program. Not open to non-degree graduate students.

**BSAD 8880 ARTS AND THE EXECUTIVE (3 credits)**

The course will provide the graduate student with an understanding of the organizational and managerial issues involved in an arts organization as the role of the arts in the business community.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8900 INDEPENDENT STUDY (1-6 credits)**

In this independent study course, individual students are able to complete independent research in a business-related topic area under the supervision of a faculty member. Written independent study reports are expected to include appropriate academic citations and references.

**Prerequisite(s):** Graduate and permission of MBA Advisor. Requires submission of completed Independent Study Contract to MBA Advisor prior to registration. Not open to non-degree graduate students.

**BSAD 8926 SPECIAL TOPICS IN BUSINESS (3 credits)**

This business-focused special topics course is designed to provide students the opportunity to focus on a current or emerging topic in any area of business. An in depth exploration of the topic will be undertaken with the expectation that students will play an active role in the course and engage deeply with the material and concepts addressed within the focal topic area. (Cross-listed with BSAD 4920).

**Prerequisite(s):** Not open to non-degree graduate students.

**BSAD 8990 THESIS (1-6 credits)**

A research project, under the supervision of a faculty thesis adviser in the College of Business Administration, in which the student establishes his capacity to design, conduct and complete an independent, scholarly investigation of a high originality. The research topic and the completed project must be approved by the student's faculty thesis adviser and two other faculty members, one of whom must be from outside the program area.

**Prerequisite(s):** Permission of graduate adviser. Not open to non-degree graduate students.



**CSCI 8000 ADVANCED CONCEPTS IN PROGRAMMING LANGUAGES (3 credits)**

Logic/Declarative programming is an important programming paradigm in which problems are described in terms of the properties they possess. As a result, in this style of programming many algorithmic elements, which explicitly must be articulated when writing programs in other programming languages, can be omitted. Core elements of logic programming play important roles in AI.

**Prerequisite(s):** CSCI 3320; CSCI 3660; CSCI 4220. Not open to non-degree graduate students.

**CSCI 8010 FOUNDATIONS OF COMPUTER SCIENCE (3 credits)**

This is a foundational course for students enrolled in the graduate program in computer science. The objectives are to introduce students to a large body of concepts so that they are better prepared for undertaking the core courses in the graduate program. It is assumed that student would have programmed in a high-level language and have exposure to basic college level mathematical concepts such as logarithms, exponents, sequences, and counting principles.

**Prerequisite(s):** Students are expected to have written programs using a high-level programming language and should understand basic mathematical concepts including exponents, logarithms, sequences, and counting principles. Not open to non-degree graduate students.

**CSCI 8016 INTRODUCTION TO THE THEORY OF RECURSIVE FUNCTIONS (3 credits)**

This is a proof-oriented course presenting the foundations of Recursion Theory. We present the definition and properties of the class of primitive recursive functions, study the formal models of computation, and investigate partially computable functions, universal programs. We prove Rice's Theorem, the Recursion Theorem, develop the arithmetic hierarchy, demonstrate Post's theorem. Introduction to the formal theories of computability and complexity is also given. (Cross-listed with MATH 4010, MATH 8016, CSCI 4010).

**Prerequisite(s):** MATH 2230 or MATH 2030 with a C- or better or CSCI 3660 with a C- or better or instructor's permission.

**CSCI 8040 LARGE SCALE NETWORK ANALYSIS ALGORITHMS (3 credits)**

The course will provide a review of the properties of large complex network systems, such as those occurring in social networks, epidemiology and biological systems. We will discuss algorithms to analyze these properties, their implementations, their stability under information fluctuation and how information spreads through networks.

**Prerequisite(s):** Students should be comfortable w/ programming, have knowledge of data structures, preliminary graph algorithms, & linear algebra. Suggest Prep Courses: CSCI 4150 or CSCI 8156; CSCI 3320; MATH 4050 or Permission. Not open to non-degree graduate students.

**CSCI 8050 ALGORITHMIC GRAPH THEORY (3 credits)**

The overall of the goal is to introduce advanced concepts in graph theory, graph modeling, and graph algorithms and how they can be used to solve a wide range of problems in various application domains. The course introduces students to several applied path algorithms, clustering and partitioning techniques, network flow algorithms, and weighted matching algorithms. Other advanced concepts associated with complex networks include node centralities in graphs and community detection approaches. The course will also introduce students to key classes of graphs with a particular focus on the main classes of Perfect Graphs and their applications in scheduling, chip design, mobile computing, and Biomedical Informatics. (Cross-listed with MATH 8050).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and MATH 4150 or MATH 8156 or permission of instructor. Not open to non-degree graduate students.

**CSCI 8060 ALGORITHMIC COMBINATORICS (3 credits)**

This course includes classical combinatorial analysis graph theory, trees, network flow, matching theory, external problems, and block designs. (Cross-listed with MATH 8060).

**Prerequisite(s):** MATH 3100, CSCI 3100, MATH 8105 or CSCI 8105 or instructor's permission.

**CSCI 8080 DESIGN AND ANALYSIS OF ALGORITHMS (3 credits)**

The course provides students an understanding of advanced topics in algorithms. Main topics include: growth of functions, asymptotic notation, recurrences, divide and conquer, dynamic programming, greedy algorithms, graph algorithms, and the theory of NP-Completeness. (Cross-listed with MATH 8080).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 or equivalent. Not open to non-degree graduate students.

**CSCI 8105 APPLIED COMBINATORICS (3 credits)**

Basic counting methods, generating functions, recurrence relations, principle of inclusion-exclusion. Polya's formula. Elements of graph theory, trees and searching network algorithms. (Cross-listed with MATH 8105, MATH 3100, CSCI 3100).

**CSCI 8110 ADVANCED TOPICS IN ARTIFICIAL INTELLIGENCE (3 credits)**

An in-depth study of one or more topics selected from: search techniques, knowledge representation, knowledge programming, parallel processing in Artificial Intelligence, natural language processing, image processing, current and future directions, etc. May be repeated with different topics, with permission of adviser.

**Prerequisite(s):** CSCI 4450 or CSCI 8456 or equivalent.

**CSCI 8150 ADVANCED COMPUTER ARCHITECTURE (3 credits)**

This course will provide an in-depth understanding of the key architectural concepts governing the design of state-of-the-art high-performance computers. It will introduce methods that are commonly used to trade-off the various architectural choices to design systems with the desired cost-performance requirements. The course will provide a systems level perspective to design. The emphasis will be on the cache, memory and I/O subsystems, system interconnects leading to distributed shared-memory multiprocessor systems. Multiprocessor clusters based on message passing and high-performance processor architecture will be covered. The course will also provide a brief overview of emerging system architectures including quantum computing and those used to facilitate machine learning applications.

**Prerequisite(s):** CSCI 4350, CSCI 4500 or equivalent with permission of the instructor. Not open to non-degree graduate students.

**CSCI 8156 GRAPH THEORY & APPLICATIONS (3 credits)**

Introduction to graph theory. Representations of graphs and graph isomorphism. Trees as a special case of graphs. Connectivity, covering, matching and coloring in graphs. Directed graphs and planar graphs. Applications of graph theory in several fields such as networks, social sciences, VLSI, chemistry and parallel processing. (Cross-listed with CSCI 4150, MATH 4150, MATH 8156).

**Prerequisite(s):** MATH 2030 or permission of instructor.

**CSCI 8160 INTRODUCTION TO VLSI DESIGN (3 credits)**

Introduction to the principal concepts of integrated circuits layout. Presentation of the hardware foundations, algorithmic mathematical and graph theoretical foundations of circuit layout. Topics discussed in digital design and computer architecture classes are studied at the actual layout design level such as datapath subsystems and array subsystems. Design methodology tools and testing. Hardware descriptions languages.

**Prerequisite(s):** CSCI 3320 (or CSCI 8325), CSCI 3710 and CSCI 4350 (or CSCI 8356). Not open to non-degree graduate students.

**CSCI 8206 NUMERICAL ANALYSIS (3 credits)**

This course involves solving nonlinear algebraic equations and systems of equations, interpolation and polynomial approximation, numerical differentiation and integration, numerical solutions to ordinary differential equations, analysis of algorithms and errors, and computational efficiency. (Cross-listed with CSCI 4200, MATH 4200, MATH 8206).

**Prerequisite(s):** MATH 1970 and MATH 2050 and MATH 2350 with a C- or better or permission of instructor.

**CSCI 8210 ADVANCED COMMUNICATIONS NETWORKS (3 credits)**

Advanced study of communication networks, analysis of communication needs, special problems encountered in different types of networks, efficiency and traffic analysis and emerging hardware software technologies. Detailed "hands-on" study of the TCP/IP networking protocols.

**Prerequisite(s):** CSCI 3550 or 8555 or equivalent. Not open to non-degree graduate students.

**CSCI 8256 HUMAN COMPUTER INTERACTION (3 credits)**

Human computer interaction is concerned with the joint performance of tasks by humans and machines; human capabilities to use machines (including learnability of interfaces); algorithms and programming of the interface; engineering concerns that arise in designing and building interfaces; the process of specification, design, and implementation of interfaces; and design trade-offs. (Cross-listed with CSCI 4250).

**CSCI 8266 USER EXPERIENCE DESIGN (3 credits)**

User experience (UX) design is concerned with the application of user-centered design principles to the creation of computer interfaces ranging from traditional desktop and web-based applications, mobile and embedded interfaces, and ubiquitous computing. This course provides in-depth, hands-on experience with real world application of the iterative user-centered process including contextual inquiry, task analysis, design ideation, rapid prototyping, interface evaluation, and reporting usability findings. (Cross-listed with CSCI 4260, ACMP 4260, ACMP 8266).

**CSCI 8300 IMAGE PROCESSING AND COMPUTER VISION (3 credits)**

This course introduces the computer system structures and programming methodologies for digital image processing and computer vision. The course will cover the mathematical models of digital image formation, image representation, image enhancement and image understanding. Techniques for edge detection, region growing, segmentation, two-dimensional and three-dimensional description of object shapes will be discussed. The course will concentrate on the study of knowledge-based approaches for computer interpretation and classification of natural and man-made scenes and objects.

**Prerequisite(s):** CSCI 1620 and CSCI 3320. Not open to non-degree graduate students.

**CSCI 8306 DETERMINISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of deterministic operations research models and algorithms. Topics include linear programming, network programming, and integer programming. (Cross-listed with CSCI 4300, MATH 4300, MATH 8306).

**Prerequisite(s):** MATH 2050 with a C- or better or permission of instructor.

**CSCI 8316 PROBABILISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of probabilistic operations, research models and algorithms. Topics include Markov chains, queueing theory, inventory models, forecasting, and simulation. (Cross-listed with CSCI 4310, MATH 4310, MATH 8316).

**Prerequisite(s):** MATH 2050 and either MATH 4740 or MATH 8746 or STAT 3800 or STAT 8805 all with a C- or better or permission of instructor.

**CSCI 8325 DATA STRUCTURES (3 credits)**

This is a core that will cover a number of data structures such as tree, hashing, priority queues and graphs as well as different algorithm design methods by examining common problem-solving techniques. (Cross-listed with CSCI 3320)

**CSCI 8326 COMPUTATIONAL OPERATIONS RESEARCH (3 credits)**

Survey of computational methods used in the solution of operations research problems. Some topics may include scripting to guide optimization software, constraint programming, heuristics and metaheuristics for optimization, basic machine learning algorithms, and simulation. (Cross-listed with MATH 4320, MATH 8326, CSCI 4320).

**Prerequisite(s):** MATH 3200 or CSCI 1620, and MATH 4300 each with a grade of C- or better or permission of instructor.

**CSCI 8340 DATABASE MANAGEMENT SYSTEMS II (3 credits)**

This course is an in-depth coverage of database management systems. Students will learn important principles of query processing and query optimization, transaction processing, and various database systems architectures. After taking this course, students should also be able to identify useful resources to explore future developments in the area of database management systems.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8350 DATA WAREHOUSING AND DATA MINING (3 credits)**

This course is an in-depth coverage of data warehousing and data mining. This course starts with coverage of data warehousing (an enabling technology for data mining) and covers the entire data mining process and various data mining functionalities in detail. Students will get a chance to practice knowledge learned in the course to complete term projects related to data warehousing and/or data mining. After taking this course, students should also be able to identify useful resources to explore future developments in the area of data warehousing and data mining.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8360 MACHINE LEARNING FOR TEXT (3 credits)**

This course focuses on the fundamental techniques for extraction of various insights from text data which is ubiquitous on the Web, social media sites, emails, news articles, digital libraries, and other sources. The course topics will include concepts and techniques used by search engines to crawl, index, and rank web pages on the Web, machine learning techniques for categorization of news articles into different categories, sentiment and opinion analysis of social media chats, text summarization, and information extraction.

**Prerequisite(s):** Not open to non-degree graduate students.

**CSCI 8366 PRINCIPLES OF SECURE SYSTEM DESIGN (3 credits)**

Contemporary issues in computer security, including sources for computer security threats and appropriate reactions; basic encryption and decryption; secure encryption systems; program security, trusted operating systems; database security, network and distributed systems security, administering security; legal and ethical issues. (Cross-listed with CYBR 4360, CYBR 8366)

**CSCI 8390 ADVANCED TOPICS IN DATA BASE MANAGEMENT (3 credits)**

This course is an in-depth coverage of well-selected topic(s) in recent development of database management systems. Since new developments in DBMS are very diverse, when each time when this course is offered, it will focus on one or more specific topics, and the course can be taken multiple times for credit.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8400 ADVANCED COMPUTER GRAPHICS (3 credits)**

Computer graphics continues to play an important role in computer science. This course covers the mathematical foundations of three-dimensional representation and animation; ray tracing and path tracing rendering methods; using the graphical processing unit (GPU) for real time applications; and concludes with simulation of natural phenomenon.

**Prerequisite(s):** Bachelors degree or permission from the Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8410 DISTRIBUTED SYSTEMS AND NETWORK SECURITY (3 credits)**

The course aims at understanding the issues surrounding data security, integrity, confidentiality and availability in distributed systems. Further, we will discuss various network security issues, threats that exist and strategies to mitigate them. This course will cover topics in cryptography, public key infrastructure, authentication, hashing, digital signatures, ARP protection, IP and IPSEC, IP Tables, SSL/TLS, firewalls, etc. (Cross-listed with CYBR 8410)

**Prerequisite(s):** CSCI 8366 or equivalent(s). Not open to non-degree graduate students.

**CSCI 8420 SOFTWARE ASSURANCE (3 credits)**

Software assurance is a reasoned, auditable argument created to support the belief that the software will operate as expected. This course is an intersection of knowledge areas necessary to perform engineering activities or aspects of activities relevant for promoting software assurance. This course takes on a software development lifecycle perspective for the prevention of flaws. (Cross-listed with CYBR 8420)

**Prerequisite(s):** CSCI 8836 OR by permission of the Instructor. Not open to non-degree graduate students.

**CSCI 8430 TRUSTED SYSTEM DESIGN, ANALYSIS AND DEVELOPMENT (3 credits)**

This course examines in detail: the principles of a security architecture, access control, policy and the threat of malicious code; the considerations of trusted system implementation to include hardware security mechanisms, security models, security kernels, and architectural alternatives; the related assurance measures associated with trusted systems to include documentation, formal specification and verification, and testing, and approaches that extend the trusted system, into applications and databases and into networks and distributed systems.

**Prerequisite(s):** CSCI 8366 or equivalents, or instructor permission. Not open to non-degree graduate students.

**CSCI 8446 INTRODUCTION TO PARALLEL COMPUTING (3 credits)**

This course is an introduction to parallel computing, that is using multiple processors to execute algorithms. Topics discussed include: classification of parallel computers; shared-memory versus message passing; forms of parallelism; measures of performance; designing parallel algorithms; parallel programming and parallel languages; synchronization constructs; and operating systems for parallel computers. (Cross-listed with CSCI 4440)

**Prerequisite(s):** CSCI 4500, which may be taken concurrently, with C- or better.

**CSCI 8450 ADVANCED TOPICS IN NATURAL LANGUAGE UNDERSTANDING (3 credits)**

The course will provide in depth study of the topics in natural language processing and understanding, such as syntax, lexical and computational semantics, natural language ambiguities and their disambiguation, logical form construction and inference. The course will survey state-of-the-art natural language processing toolkits and knowledge bases that boost the development of modern language processing and understanding applications.

**Prerequisite(s):** CSCI 3320 OR CSCI 3660 OR CSCI 4450. Not open to non-degree graduate students.

**CSCI 8456 PRINCIPLES OF ARTIFICIAL INTELLIGENCE (3 credits)**

An introduction to artificial intelligence. The course will cover topics such as machine problem-solving, uninformed and informed searching, propositional logic, first-order logic, approximate reasoning, temporal reasoning, planning under uncertainty, and machine learning. (Cross-listed with CSCI 4450).

**Prerequisite(s):** CSCI 3320 with C- or better.

**CSCI 8460 FUNDAMENTALS OF ROBOTICS (3 credits)**

This course provides the core principles of robotics and the utilization of control and intelligence methodologies applied to the field of robotics. We will focus on the hands-on creation of software modules within the Robot Operating System (ROS) environment and explore how to integrate artificial intelligence techniques into a fully operational robot control system.

**Prerequisite(s):** Prior completion of undergraduate coursework in CSCI 3320 Data Structures with C- or better AND any course equivalent to this course. Basic proficiency with Python or C++ programming is recommended.

**CSCI 8476 PATTERN RECOGNITION (3 credits)**

Structures and problems of pattern recognition. Mathematics model of statistical pattern recognition, multivariate probability, Bay's decision theory, maximum likelihood estimation, whitening transformations. Parametric and non-parametric techniques, linear discriminant function, gradient-descent procedure, clustering and unsupervised learning, and feature selection algorithms. (Cross-listed with CSCI 4470)

**Prerequisite(s):** CSCI 1620 with C- or better, and MATH 2050. Recommended: MATH 4740/8746 or STAT 3800/8805.

**CSCI 8480 MULTI-AGENT SYSTEMS AND GAME THEORY (3 credits)**

This course covers advanced topics in the area of coordination of distributed agent-based systems with a focus on computational aspects of game theory. The main topics covered in this course include distributed constraint satisfaction, distributed constraint optimization, and competitive and cooperative game theory. (Cross-listed with MATH 8480)

**Prerequisite(s):** CSCI 4450 or CSCI 8456. Suggested background courses: CSCI 4480 or CSCI 8486; CSCI 8080. Not open to non-degree graduate students.

**CSCI 8486 ALGORITHMS FOR ROBOTICS (3 credits)**

This course provides an introduction to software techniques and algorithms for autonomously controlling robots using software programs called controllers. Students will be taught how to program and use software controllers on simulated as well as physical robots. (Cross-listed with CSCI 4480).

**Prerequisite(s):** CSCI 3320 with C- or better. CSCI 4450/8456 is a recommended but not essential pre-requisite.

**CSCI 8500 NUMERICAL LINEAR ALGEBRA (3 credits)**

Topics covered in this course include error propagation, solutions of nonlinear equations, solutions of linear and nonlinear systems by various schemes, matrix norms and conditioning, and computation of eigenvalues and eigenvectors. (Cross-listed with MATH 8500).

**Prerequisite(s):** MATH 1960 and MATH 2050, or permission of instructor. Familiarity with computer programming is assumed.

**CSCI 8506 OPERATING SYSTEMS (3 credits)**

Operating system principles. The operating system as a resource manager; I/O programming, interrupt programming and machine architecture as it relates to resource management; memory management techniques for uni-multiprogrammed systems; process description and implementation; processor management (scheduling); I/O device, controller, and channel management; file systems. Operating system implementation for large and small machines. (Cross-listed with CSCI 4500).

**Prerequisite(s):** CSCI 3710, CSCI 3320/8325, MATH 1950, and CSCI 4350/8356 with C- or better.

**CSCI 8510 NUMERICAL DIFFERENTIAL EQUATIONS (3 credits)**

Topics covered in this course include interpolation and approximations, numerical differentiation, numerical integration, and numerical solutions of ordinary and partial differential equations. (Cross-listed with MATH 8510).

**Prerequisite(s):** MATH 1970, MATH 2350, or permission of instructor. Familiarity with computer programming is assumed.

**CSCI 8520 ADVANCED TOPICS IN OPERATIONS RESEARCH (3 credits)**

Advanced treatment of a specific topic in the area of operations research not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with MATH 8520).

**Prerequisite(s):** MATH 4300 or MATH 8306 or CSCI 4300 or CSCI 8306 or permission of the instructor.

**CSCI 8530 ADVANCED OPERATING SYSTEMS (3 credits)**

State-of-the art techniques for operating system structuring and implementation. Special purpose operating systems. Pragmatic aspects of operating system design, implementation and use.

**CSCI 8555 COMMUNICATION NETWORKS (3 credits)**

This course is designed to bring students up to the state of the art in networking technologies with a focus on Internet. It will cover the principles of networking with an emphasis on protocols, implementations and design issues. (Cross-listed with CSCI 3550)

**Prerequisite(s):** (CSCI 3320 or CSCI 8325 with grade of C- or better) AND (CSCI 2240 or CYBR 2250 with grade of C- or better)

**CSCI 8566 NUMBER THEORY & CRYPTOGRAPHY (3 credits)**

An overview of one of the many beautiful areas of mathematics and its modern application to secure communication. The course is ideal for any student who wants a taste of mathematics outside of, or in addition to, the calculus sequence. Topics to be covered include: prime numbers, congruences, perfect numbers, primitive roots, quadratic reciprocity, sums of squares, and Diophantine equations. Applications include error-correcting codes, symmetric and public key cryptography, secret sharing, and zero knowledge proofs. (Cross-listed with CSCI 4560, MATH 4560, MATH 8566).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better or CSCI 2030 with a C- or better or permission of instructor

**CSCI 8590 FUNDAMENTALS OF DEEP LEARNING (3 credits)**

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of neural networks. Deep learning trains the machine to learn patterns that it is presented with rather than requiring the human operator to define the patterns that the machine should look for. Deep learning is behind many recent advances in artificial intelligence, such as face recognition, speech recognition and autonomous driving. This course will cover the foundations of deep learning, learning theory, basic/advanced neural networks and problem domains of many selected applications.

**Prerequisite(s):** CSCI 3320 or instructor permission

**CSCI 8610 FAULT TOLERANT DISTRIBUTED SYSTEMS (3 credits)**

This course is to study the theory and practice of designing computer systems in the presence of faulty components. Emphasizes the basics of how faults can affect systems and what is required to mask or compensate for their efforts.

**Prerequisite(s):** Not open to non-degree graduate students.

**CSCI 8620 MOBILE COMPUTING AND WIRELESS NETWORKS (3 credits)**

The objective of the course is to introduce contemporary issues in mobile computing and wireless networks. The course covers the differences between mobile computing and the traditional distributed computing paradigm, impediments of the mobile and wireless environments, problems and limitations due to such impediments, various network layers solutions, location management techniques, mobile IP, wireless LANs, wireless TCP, ad hoc networks, and sensor networks.

**Prerequisite(s):** CSCI 3550 or CSCI 8555. Not open to non-degree graduate students.

**CSCI 8626 COMPUTER GRAPHICS (3 credits)**

An introduction to the acquisition, manipulation and display of graphical information using digital techniques. Topics include discussion of the various hardware devices used for input and output, the classical algorithms and data structures used in manipulation of graphical objects, the user interface to the graphics system, and applicable standards. (Cross-listed with CSCI 4620).

**Prerequisite(s):** ISQA 3300 or CSCI 3320.

**CSCI 8656 INTRODUCTION TO CLOUD COMPUTING (3 credits)**

This course is an introduction to cloud computing. The students will learn about core concepts of cloud computing such as cloud models (IaaS, PaaS, SaaS, etc.), deployment models (public, private, hybrid), cloud infrastructures (compute, networking, storage), cloud services (VMs, serverless, object storage, cache, CDN, etc.), and big-data driven systems. This course will revisit essential topics in CS-related courses such as data structure, operating systems, and distributed systems and show how they are utilized and applied in diverse cloud computing technologies and systems including Hadoop, Spark, and distributed databases. After taking this course, students will have basic knowledge of cloud computing and hand-on experiences with diverse projects (including cloud system demos) that utilize diverse and heterogeneous cloud resources. (Cross-listed with CSCI 4650).

**Prerequisite(s):** Prior experience and background knowledge of networking and operating systems are preferred

**CSCI 8666 AUTOMATA, COMPUTABILITY, AND FORMAL LANGUAGES (3 credits)**

This course presents a sampling of several important areas of theoretical computer science. Definition of formal models of computation and important properties of such models, including finite automata and Turing machines. Definition and important properties of formal grammars and their languages. Introduction to the formal theories of computability and complexity. (Cross-listed with CSCI 4660, MATH 4660, MATH 8666).

**Prerequisite(s):** MATH 2030. Recommended: CSCI 3320/CSCI 8325.

**CSCI 8700 SOFTWARE SPECIFICATIONS AND DESIGN (3 credits)**

A continuation of the study of software engineering with an emphasis on early phases of software development, namely requirements engineering/specification and architectural design. Includes an in-depth study of practices for effective software requirements specification and architectural design, as well as formal specifications of software systems. Related topics such as metrics and support tools are also covered.

**Prerequisite(s):** CSCI 4830 or CSCI 8836. Not open to non-degree graduate students.

**CSCI 8706 COMPILER CONSTRUCTION (3 credits)**

Assemblers, interpreters and compilers. Compilation of simple expressions and statements. Analysis of regular expressions. Organization of a compiler, including compile-time and run-time symbol tables, lexical scan, syntax scan, object code generation and error diagnostics. (Cross-listed with CSCI 4700).

**CSCI 8710 MODERN SOFTWARE DEVELOPMENT METHODOLOGIES (3 credits)**

Designed to introduce students to advanced object technology and other modern methodologies for developing software systems. Intended for graduate students who have mastered the basic concepts and issues of software engineering. Course covers advanced object-oriented software development. The course also covers several offshoots of object technology, including: component-based software engineering, aspect-oriented software development, software product line engineering, service-oriented computing, etc.

**Prerequisite(s):** CSCI 4830 or CSCI 8836.

**CSCI 8760 FORMAL METHODS IN SOFTWARE ENGINEERING (3 credits)**

In the high consequence system domain, a primary objective of any construction technique employed is to provide sufficiently convincing evidence that the system, if put into operation, will not experience a high consequence failure or that the likelihood of such a failure falls within acceptable probabilistically defined limits. Systems for which such evidence can be provided are called high assurance systems. The objective of this course is to examine software-engineering techniques across the development life cycle that are appropriate for high assurance systems. The course will analyze the nature of the evidence provided by various techniques (e.g., does a given technique provide sufficiently strong evidence in a given setting).

**Prerequisite(s):** CSCI 8000 and CSCI 8836 or CSCI 4830



**CSCI 8766 TOPICS IN MODELING (3 credits)**

Selection of such topics as formulation and analysis of various models involving Markov chains, Markov processes (including birth and death processes), queues, cellular automata, difference and differential equations, chaotic systems and fractal geometries. (Cross-listed with CSCI 4760).

**Prerequisite(s):** MATH 2350 and MATH 4740 or MATH 8746.

**CSCI 8790 ADVANCED TOPICS IN SOFTWARE ENGINEERING (3 credits)**

The main objective of this course is (1) to introduce advanced topics in software engineering approaches and (2) to provide an overview and in-depth understanding of software development and maintenance techniques. Many well-known software implementation problems, associated programming tools, and analysis techniques are also covered. At the end of this course, the student should be able to apply the practical skills and approaches in solving non-trivial problems in diverse fields of study.

**Prerequisite(s):** CSCI 4830 or CSCI 8836. Not open to non-degree graduate students.

**CSCI 8836 INTRODUCTION SOFTWARE ENGINEERING (3 credits)**

Basic concepts and major issues of software engineering, current tools and techniques providing a basis for analyzing, designing, developing, maintaining and evaluating the system. Technical, administrative and operating issues. Privacy, security and legal issues. (Cross-listed with CSCI 4830).

**CSCI 8856 DATABASE MANAGEMENT SYSTEMS (3 credits)**

Basic concepts of data base management systems (DBMSs). The relational, hierarchical and network models and DBMSs which use them. Introduction to data base design. (Cross-listed with CSCI 4850).

**CSCI 8876 DATABASE SEARCH AND PATTERN DISCOVERY IN BIOINFORMATICS (3 credits)**

This required course for undergraduate bioinformatics majors provides foundational knowledge on database aspects used in the field and an overview of their applications in bioinformatics, biomedical informatics, and health/clinical informatics. The course begins with a brief review of key concepts in computational molecular biology related to database search/development, database management systems, the difference between primary and secondary databases, and bioinformatics-related aspects of modeling and theory in computer science. The major focus is on the multiple challenges and aspects of bio-database development, search, and pattern discovery. The course uses problem-based learning to help students develop database management skills as they apply to high throughput "-omics." data, the basics of data management, data provenance and governance, standards, and analysis through KDD-based workflows. This course will also consider the fundamentals of artificial intelligence and machine learning as they pertain to bioinformatics, from the perspective of database storage, I/O, and analysis. (Cross-listed with BIOI 4870)

**Prerequisite(s):** CSCI 3320 and BIOI 3500, or permission of instructor; BIOI 3500 can be taken concurrently. Prior completion of CSCI 4850 is strongly recommended but not required. Not open to non-degree graduate students.

**CSCI 8910 MASTER OF SCIENCE CAPSTONE (3 credits)**

The capstone course is to integrate coursework, knowledge, skills and experimental learning to enable the student to demonstrate a broad mastery of knowledge, skills, and techniques across the Master degree curriculum of Computer Science for a promise of initial employability and further career advancement. The course is designed to be in a student-centered and student-directed manner which requires the command, analysis and synthesis of knowledge and skills. Students may apply their knowledge and skill to a project which serves as an instrument of evaluation. Students are encouraged to foster an interdisciplinary research and cultivate industry alliances and cooperation in this course. This capstone course should be taken only after students have completed at least 3/4 of course requirements for the major.

**Prerequisite(s):** Master's degree of Computer Science with course-only option (program III). Not open to nondegree students.

**CSCI 8920 ADVANCED TOPICS COMPUTER SCIENCE (3 credits)**

An in-depth study, at the graduate level, of one or more topics that are not treated in other courses. May be repeated with different topics with permission of adviser.

**Prerequisite(s):** Permission of instructor; will vary with offering. Not open to non-degree graduate students.

**CSCI 8950 GRADUATE INTERNSHIP IN COMPUTER SCIENCE (1-3 credits)**

The purpose of this course is to provide students with opportunities to apply their academic studies in environments such as those found in business, industry, and other non-academic organizations. The student interns will sharpen their academic focus and develop better understanding of non-academic application areas.

**Prerequisite(s):** Permission of the graduate program chairperson and a minimum grade point average of 3.0 (B), with at most one grade below B, but not lower than C+ for all CS graduate classes. Not open to non-degree graduate students.

**CSCI 8960 THESIS EQUIVALENT PROJECT IN COMPUTER SCIENCE (1-6 credits)**

This course allows a graduate student to conduct a research project in computer science or a related area. The project is expected to place an emphasis on applied, implementations-based, or experimental research. The process for development and approval of the project must include: appointment of supervisory committee (chaired by project adviser), a proposal approved by the supervisory committee, monitoring of the project by the supervisory committee, an oral examination over the completed written product conducted by the supervisory committee, and final approval by the supervisory committee. The approved written project will be submitted to the Office of Graduate Studies by the advertised deadlines.

**Prerequisite(s):** Permission of Graduate Adviser. Not open to non-degree graduate students.

**CSCI 8970 INDEPENDENT STUDY (1-3 credits)**

Under this number a graduate student may pursue studies in an area that is not normally available in a formal course. The topics to be studied will be in a graduate area of computer science to be determined by the instructor.

**Prerequisite(s):** Permission of the Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8980 GRADUATE SEMINAR (1 credit)**

This course offers an up-to-date coverage of the contemporary and emerging concepts, models, techniques and methodologies, and/or the current research results in the fundamental areas of computer science. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** Permission of the Instructor. Not open to non-degree graduate students.

**CSCI 8986 TOPICS IN COMPUTER SCIENCE (3 credits)**

This is a variable topic course in computer science at the senior/graduate level. Topics not normally covered in the computer science degree program, but suitable for senior/graduate-level students can be offered. (Cross-listed with CSCI 4980).

**Prerequisite(s):** Permission of instructor. Additional prerequisites may be required for particular topic offerings.

**CSCI 8990 THESIS (1-6 credits)**

A research project, designed and executed under the supervision of the chair and approval by members of the graduate student's thesis advisory committee. In this project the student will develop and perfect a number of skills including the ability to design, conduct, analyze and report the results in writing (i.e., thesis) of an original, independent scientific investigation.

**Prerequisite(s):** Permission of Graduate Adviser. Not open to non-degree graduate students.

**CSCI 9410 ADVANCED TOPICS IN LOGIC PROGRAMMING (3 credits)**

This course will examine some advanced topics in logic programming, in particular logic programming under stable model (or answer set) semantics. Answer set programming is a common name of the field. Formal syntax, semantics, and proofs of correctness for logic programs will be considered. Elements of inductive and Prolog programming will also be introduced. Each advanced topic will be followed by how it has been applied in practice. Advanced applications of logic programming will be covered in detail.

**Prerequisite(s):** CSCI 8000 and doctoral student standing in Information Technology or the permission of the instructor.

**CSCI 9420 INTELLIGENT AGENT SYSTEMS (3 credits)**

This course covers the principles of interaction between agents in multi-agent systems using game theory. Relevant topics studied in this course include competitive games, statistical Bayesian games, cooperative games, and mechanism design. Students will have to implement projects related to the material studied in the course.

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and CSCI 4450 or CSCI 8456. Not open to non-degree graduate students.

**CSCI 9710 METHODS IN SOFTWARE ENGINEERING RESEARCH (3 credits)**

This course provides guidelines on how to conduct research in the field of software engineering by presenting the research methods, classic readings, and development of theories and their application to real life problems. The main emphasis of the course is to provide opportunity for in-depth study of topics such as contemporary methods for software development.

**Prerequisite(s):** CSCI 8836 or equivalent course and doctoral student standing in Information Technology or permission of the instructor. Not open to non-degree graduate students.

**CSCI 9810 RESEARCH FOUNDATIONS IN THEORETICAL COMPUTING (3 credits)**

This course offers an up-to-date coverage of the contemporary and emerging concepts, models, techniques, and methodologies, and/or the current research results in the fundamental areas of theoretic computing. The course will examine advanced research topics in computer science and engineering, including foundations of automata theory, computability, complexity analysis, computational logics and algorithmic analysis, hybrid dynamic systems theory, number theory, adaptation and learning theory, concepts and principles in computational geometry, stochastic processes, and random optimization. Each topic will be discussed with a perspective of research issues and directions. Active student participation in investigation of the research topics, survey of the current state-of-art, and identifying the future research insights is required. Students will take turn presenting their research results on specific topics. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** The prerequisites of this course vary depending on the areas to be covered in the semester the course is offered. Good standing in Ph.D. program is required. Permission of the instructor may be required. Not open to non-degree graduate students.

**ECON 8010 SEMINAR IN PUBLIC FINANCE (3 credits)**

This course is designed to develop the tools of applied welfare economics and to use these tools to evaluate the expenditure and tax decisions of governments. The structure, effects and reform of the U.S. individual and corporate income taxes, social security and healthcare system will be emphasized. Government debt and deficits will also be discussed.

**Prerequisite(s):** ECON 3200 or ECON 8210 or BSAD 8100 or permission

**ECON 8050 ECONOMIC EDUCATION (3 credits)**

A study and examination of economic principles and how they can be related to the teacher's classroom presentation. This course is designed to furnish the k-12 teacher with sufficient background and understanding to aid in the recognition of economic issues and the teaching of economic concepts and principles.

**Prerequisite(s):** No previous course work in economics. Not open to Economics majors.

**ECON 8080 MONEY AND FINANCIAL INSTITUTIONS (3 credits)**

This course examines the financial system (institutions, instruments, markets, practices, and public authorities), and the implementation of monetary policy that aims to maintain financial stability and support economic growth. The course discusses current events reported in the financial press and uses the analytic frameworks developed in class to analyze these issues. This course trains students to think systematically about the current state of the economy and use quantitative tools to analyze the interactions between monetary policy and the financial system.

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8200 SEMINAR IN MICRO ECONOMIC THEORY (3 credits)**

The course covers major topics in microeconomic theory. The major topics covered are the theory of consumer behavior, theory of production and cost, theory of the firm, pure exchange economy, general equilibrium, and welfare theory.

**Prerequisite(s):** ECON 3200, ECON 3220 and ECON 8306 or permission.

**ECON 8210 APPLIED MANAGERIAL ECONOMICS (3 credits)**

This is a course in empirical economic modeling techniques deployed by economists and other business consultants use in business and public policy applications. There are four main themes: 1) techniques used in demand analysis and economic forecasting, 2) techniques used in production and cost analysis, 3) supply chain and trade analysis, and 4) analysis and measurement of competitive interactions.

**Prerequisite(s):** ECON 2200 or equivalent, or permission of the instructor.

**ECON 8216 INDUSTRIAL ORGANIZATION (3 credits)**

In this class we will examine why firms and industries behave the way that they do. We will explore why some industries face intense competition while others enjoy large profits, why some industries offer only bundles, and why some firms buy up their supply chain when others do not. This theoretical course will illuminate un-theoretical implications to your life and future business ventures. This course will use your economic knowledge, a bit of psychology (behavioral economics) and game theory to answer questions like "Why does everyone hate the cable company?" and "Why are CEOs given so many stock options?" (Cross-listed with ECON 4210).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8220 SEMINAR IN MACRO THEORY (3 credits)**

This course traces the development of macroeconomic theory from the classical point of view to current schools of thought. Keynesian, neo-Keynesian and neo-classical models are developed.

**Prerequisite(s):** ECON 3200 or ECON 8210 or BSAD 8100, ECON 3220, and ECON 8306, or permission.

**ECON 8230 BUSINESS CONDITIONS ANALYSIS (3 credits)**

This course is concerned with the statistical measurement and evaluation of general business conditions, as well as the adaptation of business policies to changing business conditions. Emphasis is placed upon the practical application of statistical analysis techniques to business situations within the framework of the aggregate economy.

**Prerequisite(s):** ECON 2200 and ECON 2220.

**ECON 8246 LABOR ECONOMICS (3 credits)**

The course will cover essential topics in Labor Economics including factors leading to equilibrium conditions in the labor market, human capital accumulation, discrimination in the workplace, compensation for undesirable work, mobility, unionization, and more. (Cross-listed with ECON 4240).

**Prerequisite(s):** ECON 2200 OR BSAD 8150 OR Instructor Approval

**ECON 8256 SPORTS ECONOMICS (3 credits)**

Economics is frequently considered an abstract topic, with interesting results that are not easily applied in the real world. Through Sports Economics, students will explore the very real ways in which economics influences sporting competitions and the businesses surrounding them. Students will explore topics such as unionization in sports, discrimination, amateurism, monopoly power, game theory, and more in the context of sports, giving the student a deeper understanding of how these topics apply to real-world problems. After this course, students will understand how readily economics can be applied to businesses and problems in any industry or domain. (Cross-listed with ECON 4770).

**Prerequisite(s):** ECON 2200 OR BSAD 8150 OR Equivalent OR Instructor Approval. Not open to non-degree graduate students.

**ECON 8290 RESEARCH METHODS IN ECONOMICS AND BUSINESS (3 credits)**

Covers the methodology of economics: choosing a research topic, literature search tools, data source identification, data summary techniques, basic statistical data analysis using statistical packages, and clear economics writing. The student will become familiar with these techniques through text materials, journal studies, and completion of an empirical economics paper.

**Prerequisite(s):** ECON 3200, ECON 3220, or equivalents, or permission of the instructor. Not open to non-degree graduate students.

**ECON 8300 ECONOMETRICS (3 credits)**

The study of the underlying assumptions, techniques and applications of single and multiple equation regression analysis in economics.

**Prerequisite(s):** Basic Statistics, ECON 8306/ECON 4300, or permission. Not open to non-degree graduate students.

**ECON 8306 QUANTITATIVE APPLICATIONS IN ECONOMICS AND BUSINESS (3 credits)**

The study and application of modern quantitative techniques to problem-solving in economics and business. It is designed to help the student to translate verbal arguments in economics and business into their mathematical equivalents, to improve analytical skills, and to attain proficiency in marginal analysis, equilibrium analysis, static optimization, and comparative statics analysis. It covers topics such as exponential and logarithmic functions and their applications, linear algebra and its applications, derivatives and their applications, maximization of functions with one variable and multi variables, maximization with non negativity constraints, and integral calculus and its applications in economics and business. (Cross-listed with ECON 4300).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180.

**ECON 8310 BUSINESS FORECASTING (3 credits)**

The course will cover forecasting tools and applications applied to business settings. The first half of the course will cover traditional Econometric forecasting methods and the second half of the course will focus on predictive analytics models and machine learning. Time in the computer lab will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with BSAD 8080).

**Prerequisite(s):** ECON 8320 (or equivalent programming experience) or permission of instructor. Not open to non-degree graduate students.

**ECON 8316 BUSINESS INTELLIGENCE AND REPORTING (3 credits)**

The course will teach students to use state-of-the-art Business Intelligence (BI) software to generate reports and information from data. BI software is used to inform decision-making in industries from transportation to medicine, from marketing to government, and is facilitated by rapidly increasing access to data in all industries. Students will learn to employ best practices in visualization and verbal communication as they are trained to create valuable insights from data and convey those insights to stakeholders. Additionally, the course will aid students in preparing for certification in the use of state-of-the-art BI software. (Cross-listed with ECON 4350).

**Prerequisite(s):** BSAD 2130 (or equivalent) OR Instructor Approval

**ECON 8320 TOOLS FOR DATA ANALYSIS (3 credits)**

The course will cover basic principles of programming languages, as well as libraries useful in collecting, cleaning and analyzing data to answer research questions. The course will utilize basic Economic principles and Econometric methods as inspiration for assignments and projects throughout the duration of the course, and will do so in a way that is accessible to non-Economists. This course is intended to introduce the student to the Python programming language as a tool for conducting data analysis. While the course uses Python, the student should be able to move to other languages frequently used in data analysis using the principles taught in this course.

**Prerequisite(s):** BSAD 2130 or equivalent; or instructor approval.

**ECON 8326 NATURAL RESOURCE ECONOMICS (3 credits)**

This course introduces students to the economics and management of Earth's natural resources. We address questions such as: Are we running out of natural resources? Are we using resources in a sustainable fashion? What role do markets play in resource use? We will address issues related to fossil-based resources, minerals, fisheries, water, land, forests and other associated topics. The course covers the basic theoretical framework for understanding the optimal rate of resource use, identifies the factors that determine the actual rate of use, and considers and evaluates various public policy prescriptions. (Cross-listed with ECON 4320).

**Prerequisite(s):** ECON 2200 and ECON 2220, BSAD 8150 or permission of instructor.

**ECON 8330 DATA ANALYSIS FROM SCRATCH (3 credits)**

Econometrics is routinely taught as an application class using a 'black box' like Stata or SAS to perform calculations. This class takes a different approach. Using the Python programming language, we build all estimators from scratch. Additionally, we introduce numerous non-parametric and simulation techniques. This approach to econometrics results in a stronger understanding of statistical assumptions and methods, a better understanding of when a method is appropriate, and stronger programming techniques. Furthermore, a deeper understanding of the underlying mechanics provides the student the ability to program custom procedures not already built into popular software packages. As part of the course, students will work with a community partner to answer a real question with data; MBA students should consult with their advisor about this course satisfying the project-focused capstone requirement.

**Prerequisite(s):** A multivariate or regression analysis course such as ECON 8300, ISQA 9130 or STAT 8436, and a programming class such as ECON 8320 or equivalent programming experience; or instructor approval. Not open to non-degree graduate students.

**ECON 8336 ENVIRONMENTAL ECONOMICS AND SUSTAINABILITY (3 credits)**

In this course students will apply economic concepts and models to environmental concerns and policy solutions that combat environmental degradation. Topics include: Air and water pollution, solid waste management, carbon taxation, cap-and-trade systems, and economic motivations for sustainable business management. (Cross-listed with ECON 4330).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor.

**ECON 8346 ECONOMICS OF TECHNOLOGY (3 credits)**

Innovative dynamism is the economic system which brings us the new goods and processes that make life longer and better. We will examine how the system works, including: The role of the breakthrough inventor and the innovative entrepreneur; whether the system improves or hurts ethical behavior, culture, equality, and the environment; the costs to workers in terms of job loss, and the benefits to workers in terms of the creation of better jobs; how funding, regulatory, and patent policies affect innovative dynamism; and how innovative dynamism in medicine can result in more and faster cures for cancer and other diseases. (Cross-listed with ECON 4340).

**Prerequisite(s):** ECON 2200 or BSAD 8180 or permission of the instructor.

**ECON 8456 DOMESTIC MONETARY THEORY AND POLICY (3 credits)**

The course will introduce students to topics in money and banking, financial institutions, markets, financial instruments, and monetary theory in order to enhance financial decision making and enable students to effectively analyze economic news in media such as the Wall Street Journal, The New York Times, Business Week, Barrons, The Economist, and other related business publications. This knowledge will enable students to formulate their own views about the current economic environment, government policies, and responses to economic environments. (Cross-listed with ECON 4450).

**ECON 8576 ECONOMIC CONDITIONS ANALYSIS (3 credits)**

This course teaches students how to conduct an economic analysis of, and produce an economic forecast for, a local economy such as a state, county, or metropolitan area. Students will learn where to find data, how to analyze that data, how to develop models with the data, and how to present the data in a clear, concise, and jargon-free manner. The final published report will be authored by the students registered in the course. All students will contribute equally to the final report. The instructor will ensure equal participation. (Cross-listed with ECON 4570).

**Prerequisite(s):** ECON 2200 and ECON 2220, or Permission from the instructor

**ECON 8616 INTERNATIONAL TRADE (3 credits)**

An analysis of the character of international economic relations. Subjects covered include the economic basis for international specialization and trade, the economic gains from trade, commercial policy, economic integration and economic growth. (Cross-listed with ECON 4610).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8626 INTERNATIONAL MONETARY THEORY (3 credits)**

This course is designed to introduce students to topic areas in International Macroeconomics and International Finance. Students will examine the mechanisms of the foreign exchange market, and how exchange rates are determined in the short-run as well as in the long-run. Students will investigate the different exchange rate regimes around the world, including fixed exchange rates, floating exchange rates, crawling pegs, and other arrangements. Students will examine the European Union and ask whether such a system is economically viable. This is especially important in the current economic environment facing Europe. Students will also examine exchange rate crises over history, and examine how they all have common elements. (Cross-listed with ECON 4620).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8666 INTERNATIONAL ECONOMIC DEVELOPMENT (3 credits)**

This course introduces theories and application of economic development and growth, economic problems facing developing countries, analyzes domestic economic issues (e.g., per capita GDP, income distribution, population, unemployment, urbanization, education, fiscal policies, and financial policies), and international economic issues (e.g., trade, foreign investment, and foreign debt). Financial crises, debt crises, and economic recovery will be discussed. (Cross-listed with ECON 4660).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8736 ECONOMICS OF ENTREPRENEURSHIP (3 credits)**

This course will review economic theories of entrepreneurship with special emphasis on Schumpeter's theory of creative destruction. The main focus of the seminar will be on the "high-level" entrepreneurship that sometimes results in major innovations. This course will address the societal benefits of entrepreneurship, factors influencing entrepreneurial success, the policies that best encourage entrepreneurship, and how firms can survive and prosper in an entrepreneurial environment. (Cross-listed with ECON 4730, BSAD 8736.)

**Prerequisite(s):** ECON 2200 or permission of the instructor for all students.

**ECON 8856 ECONOMICS OF URBAN AND REGIONAL DEVELOPMENT (3 credits)**

This course will consider factors and trends in development at the global and national level but will focus primarily on economic development at the state, local, and regional levels in the United States. The focus of this course will be real world strategic planning for economic development. (Cross-listed with ECON 4850).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8910 SPECIAL STUDIES IN ECONOMICS (3 credits)**

This course will focus on issues or developments in a specific area of economics or business.

**Prerequisite(s):** Graduate student in good standing and as indicated for specific workshop or seminar.

**ECON 8920 INDEPENDENT STUDY (1-3 credits)**

Guided independent study and research.

**Prerequisite(s):** Graduate student in economics and permission of instructor.

**ECON 8940 ECONOMIC INTERNSHIP (1-3 credits)**

Guided internship in a firm or organization that makes use of, or extends, the student's skill in economics.

**Prerequisite(s):** Completion of at least nine hours of graduate level economics and permission of instructor.

**ECON 8990 THESIS (1-6 credits)**

An independent research project, written under the supervision of a graduate adviser in the department of economics. Approval of the topic and the completed project by departmental committee is required.

**Prerequisite(s):** Approval of the topic and the completed project by departmental committee is required.

**ISQA 8016 BUSINESS INTELLIGENCE (3 credits)**

This course intends to provide graduate students in-depth exposure to the growing field of business intelligence. Business intelligence (BI) consists of the set of concepts and techniques used to analyze business data in support of decision-making and planning. BI spans a number areas of management information systems, including Decision Support Systems (DSS), Enterprise Resource Planning (ERP), Data Warehousing, Knowledge Management, Customer Relationship Management, Data Mining, and others.

**Prerequisite(s):** (ISQA 4150 or ISQA 8156) and ISQA 8040 and ISQA 8050. Not open to non-degree graduate students.

**ISQA 8030 INFORMATION SYSTEMS AND ETHICS (3 credits)**

This course gives you an introduction to organizations and the role that information and information systems play in supporting an organization's operations, decision-making processes, quality management, and strategic activities. The course provides an introduction to the management of information systems function, the strategic and regulatory issues of telecommunications, and ethical and legal issues related to information systems.

**Prerequisite(s):** Admission into the MS in MIS program.

**ISQA 8040 AN OVERVIEW OF SYSTEMS DEVELOPMENT (3 credits)**

The course presents an overview of the systems development lifecycle and database development. The course will focus on theory, current tools and techniques that the system developer can use to develop and document information systems. The purpose of this course is to prepare the student for further graduate-level study of information systems. This course may not be used in a plan of study for any graduate program at UNO.

**ISQA 8050 DATA ORGANIZATION AND STORAGE (3 credits)**

The course will provide concepts of data organization, data storage, and data transfer through computer networks. The performance implications of various design decisions will be explored. The purpose of this course is to prepare the student for further graduate-level study of information systems. This course may not be used in a plan of study for any graduate program at UNO.



**ISQA 8060 RESEARCH IN MIS (3 credits)**

This course covers research methods and their application to the development and evaluation of management information systems. Also covered is the relationship between organization theory and IS research.  
**Prerequisite(s):** CIST 2500, CIST 2100, and ISQA 8040, or permission of the instructor.

**ISQA 8070 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (1 credit)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**ISQA 8080 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (3 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** 1) Permission of the instructor. 2) Additional prerequisite courses may be required for particular course offerings.

**ISQA 8086 SPECIAL TOPICS: INFORMATION SYSTEMS & QUANTITATIVE ANALYSIS (1-5 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once. (Cross-listed with ISQA 4000)

**Prerequisite(s):** Permission of instructor. Additional prerequisites may be required for particular topic offerings.

**ISQA 8090 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (2 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**ISQA 8106 INFORMATION SYSTEMS ARCHITECTURE AND ORGANIZATION (3 credits)**

This course examines the frameworks and tools used to develop an organization's information system architecture. It provides the analytical skills and conceptual frameworks with which to make recommendations and decisions regarding the integration of information technology components into an information system architecture. (Cross-listed with ISQA 4100)

**Prerequisite(s):** CIST 2100 and ISQA 3310

**ISQA 8136 INFORMATION TECHNOLOGY FOR DEVELOPMENT (3 credits)**

Information Technology for Development (ITD) is the implementation and evaluation of information technology infrastructures to stimulate economic, social and human development. In this service-learning course, students will learn and apply ITD concepts for developing and adding value through IT by working with small business entrepreneurs in Omaha or rural Nebraska. Students will evaluate micro-business technology needs, prepare business technology plans, provide training, and implement appropriate solutions, to the extent possible within a semester class. (Cross-listed with ISQA 4130)

**Prerequisite(s):** Though not required, the following courses or their equivalent would provide the necessary background : CIST 1100, CIST 1300, ISQA 3210, ISQA 3310, ISQA 3400. Not open to non-degree graduate students.

**ISQA 8156 ADVANCED STATISTICAL METHODS FOR IS&T (3 credits)**

This course emphasizes the application and interpretation of statistical methods including design of experiments, analysis of variance, multiple regression, and nonparametric procedures and the use of statistical computer packages. The intent is to develop quantitative abilities needed for quantitatively intensive jobs and for advanced study in management information systems, computer science and information technology. (Cross-listed with ISQA 4150)

**Prerequisite(s):** CIST 2500 or equivalent (at least one course in statistics)

**ISQA 8160 APPLIED DISTRIBUTION FREE STATISTICS (3 credits)**

The primary objective of this course is to expose students to methods of analyzing data from non-normal populations including binomial tests, contingency tables, use of ranks, Kolmogorov-Smirnov type statistics and other selected topics.

**Prerequisite(s):** Admission to MS program in Management Information Systems or permission of instructor. This course assumes prior knowledge with basic descriptive and inferential statistics from an introductory undergraduate course (e.g., CIST 2500).

**ISQA 8166 ENTERPRISE RESOURCE PLANNING SOFTWARE CONSULTING (3 credits)**

Enterprise Resource Planning (ERP) consulting is designed to provide students foundational knowledge required to become a consultant working with enterprise systems. ERP systems are used by most organizations to manage and integrate the core functions of a business. Students will be exposed to a broad range of consulting skills that spans package selection to the implementation process. Students will work with a live instance of an ERP system focusing on the cross-functional integration of core business processes primarily in a manufacturing environment including finance, operations/supply chain, procurement, and fulfillment. The goal of the course is to provide students a foundation for careers in the area of ERP systems and consulting. (Cross-listed with ISQA 4160, SCMT 4160)

**ISQA 8176 DIGITAL SUPPLY CHAIN & LOGISTICS (3 credits)**

Global Supply Chains are being disrupted by digital transformation driven by emerging technologies such as IoT (internet of things) and AI/ML (Artificial Intelligence/Machine Learning). This course will take a closer look at global supply chains and logistics with an emphasis on the impact of digitalization. We will explore the typical global supply chain processes and how state-of-the-art and emerging technologies impact them. Thus, the class views global digital supply chains by integrating business and technological perspectives. The course will start with an overview of technologies relevant to digital supply chains. We will then discuss digitalization strategy and digital supply chains, fundamental GSCM (Global Supply Chain Management) processes and their potential for digitalization, and discussion of IT/software systems, IoT, AI/ML, Data Analytics/Visualization, and related facets that impact digital supply chains. The course will culminate with an integrated case study and/or research paper (graduate). (Cross-listed with ISQA 4170).

**Prerequisite(s):** It is preferable that students have taken an introductory supply chain class or have some experience in the transportation, logistics and supply chain management sector.

**ISQA 8180 ELECTRONIC COMMERCE (3 credits)**

Electronic Commerce is the digital enablement of transactions between multiple parties. A multitude of technologies, tools and applications have brought about changes in business, and society that require careful consideration. Students are given an overview of electronic commerce business models and required to apply these to solve business problems or take on opportunities presented. They will cover topics such as social networking, electronic markets, and political and ethical issues associated with electronic commerce, and business plans for technology ventures. They will apply these concepts using Web 2.0 tools, mobile applications and website design assignments.

**ISQA 8196 PROCESS REENGINEERING WITH INFORMATION TECHNOLOGY (3 credits)**

Business process reengineering issues are examined. Reengineering concepts and methods are introduced. Additional special project(s) are required. SAP will be introduced. (Cross-listed with ISQA 4190)

**Prerequisite(s):** CIST 2500; prerequisite/co-requisite ISQA 4110.

**ISQA 8206 INFORMATION AND DATA QUALITY MANAGEMENT (3 credits)**

The course primarily focuses on developing an in-depth understanding of Data and Information Quality (DQ and IQ) concepts and issues. On completing this course students will be able to understand and use DQ and IQ Concepts in Information Systems projects, be able to recognize various patterns of Data and Design Deficiencies in Systems and be able to suggest appropriate DQ and IQ improvement plans in light of known deficiencies in systems. (Cross-listed with ISQA 4200)

**Prerequisite(s):** CIST 2500

**ISQA 8210 MANAGEMENT OF SOFTWARE DEVELOPMENT (3 credits)**

This course should encourage you to think critically about aspects of software development that make it difficult and strategies to mitigate these challenges. This course integrates concepts from software engineering, management science, psychology, and organizational behavior to identify, understand, and propose solutions to problems associated with software development. We examine and consider issues from various perspectives, such as the project manager, development team, senior management, and project sponsor. This course prepares students for various roles within a software development effort including leadership positions in software development. Students will practice software project management and agile methods of managing projects in a semester long team project using contemporary project and development methods.

**Prerequisite(s):** Admitted to MS in MIS or instructor permission.

Prior knowledge assumed in SW development & relational databases - ISQA 8040/ISQA 4110 & ISQA 3310/equivalent and in web development - ISQA 3900/equivalent. Not open to non-degree graduate students.

**ISQA 8220 ADVANCED SYSTEMS ANALYSIS AND DESIGN (3 credits)**

This course is a systems analysis and design course for systems and business analysts. The course presents an overview of object-oriented system analysis and design. The course will then focus on theory, best practices, and modern methodologies that analysts can use to analyze and design information systems.

**Prerequisite(s):** ISQA 8040 or (ISQA 4110 and ISQA 4120) or equivalent and ISQA 8050 or ISQA 3310 or equivalent

**ISQA 8306 DATABASE ADMINISTRATION (3 credits)**

This course is designed to give students an applied, practical introduction to database administration. Students will gain an understanding of the functioning of a database management system and its relationship to the computing environment in which it runs. They will learn the concepts, principles, and techniques necessary to carry out such functions as database object creation, storage management, capacity planning, performance tuning, backup and recovery, and security management. Each semester the course will focus on one commercial database management system (DBMS), such as Oracle. (Cross-listed with ISQA 4300)

**Prerequisite(s):** ISQA 8040 or ISQA 3310 or CSCI 4850. Not open to non-degree graduate students.

**ISQA 8310 IT INFRASTRUCTURE & CLOUD COMPUTING (3 credits)**

This course provides a graduate-level introduction to the business and technical decisions around technical infrastructure. It covers topics related to computer and systems architecture and communications networks, with a focus on the technical and business decisions around technology. Students completing the course will be able to understand and design network infrastructure, evaluate cloud computing offerings, and communicate their decisions. The course covers hardware, software, and cloud computing technologies.

**ISQA 8340 APPLIED REGRESSION ANALYSIS (3 credits)**

The primary objective of this course is to expose students to regression models and applications with particular emphasis on applying these concepts to IT research. Topics to be discussed include: Foundations of regression analysis using least squares procedures; model formulation, stepwise regression, transformations; graphical methods, estimation; inference; influence diagnosis; matrix formulation, multicollinearity, time series, and nonlinear models.

**Prerequisite(s):** ISQA 4150 or ISQA 8156, not open to non-degree graduate students.

**ISQA 8380 ENTERPRISE ARCHITECTURE AND SYSTEMS INTEGRATION (3 credits)**

This course is designed to give students grounding in the concepts, issues, and tools needed to manage enterprise architecture, distributed systems & Internet-based environments. The goal of the course is to equip students to make the architecture and infrastructure-related decisions needed for successful development and use of contemporary client/server and Internet-based systems. Topics include middleware, architecture, XML, JSON, web services, service-oriented architecture, enterprise application integration, distributed computing services, Model View Controller (MVC) development frameworks.

**Prerequisite(s):** ISQA 8310 and ISQA 8050 or equivalent; permit required.

**ISQA 8410 DATA MANAGEMENT (3 credits)**

The course provides in-depth coverage of such areas as: the relational model, SQL, data modeling, data quality management, database design, data warehousing, business intelligence, document and content management, NoSQL systems, and data governance. The course offers a mix of theoretical treatment and hands-on application. Current DBMS and data modeling software will be used.

**Prerequisite(s):** ISQA 8050 or equivalent, permit only.

**ISQA 8420 MANAGING THE I.S. FUNCTION (3 credits)**

The course provides a focus on the business management implications of the information explosion. The course is organized around a management audit of the information services activity to help present and future managers recognize and implement effective information services management.

**Prerequisite(s):** CIST 2100 and ISQA 8040. Not open to non-degree graduate students.

**ISQA 8450 NOSQL AND BIG DATA TECHNOLOGIES (3 credits)**

The course will cover topics in the area of NoSQL and Big Data management. The course is intended to get students familiarized with NoSQL and Big Data technologies, explore how these database technologies differ conceptually from traditional relational database technologies, understand their applications, uses, advantages, and disadvantages, and provide hands-on experience with NoSQL and Big Data databases. The course offers a mix of theoretical treatment and hands-on application of the discussed NoSQL and Big Data technologies.

**Prerequisite(s):** Prior exposure to data management is expected. The prereq is: ISQA 3310, ISQA 8040, CSCI 4850, or work experience that has given you a comparable grounding in database concepts and technologies; in this case permission by the instructor is needed.

**ISQA 8460 INTERNET OF THINGS (IOT), BIG DATA AND THE CLOUD (3 credits)**

This course introduces the Internet of Things (IoT). It provides an overview of a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. In the future, the "Things" in question may have identities and virtual personalities, operating in smart spaces using intelligent interfaces to connect and communicate with the social, environmental, and user context.

**Prerequisite(s):** Basic Web Development using HTML/CSS and some MVC framework. The equivalent of two semester exposure to programming.

**ISQA 8525 GRAPHICAL USER INTERFACE DESIGN (3 credits)**

This course is an introduction to interaction design with a primary emphasis on designing usable and useful computer interfaces. Students will learn the principles of interface design grounded in a fundamental understanding of human cognitive processes. They will learn how end-users develop and use mental models of interaction and will apply this knowledge to the design of interfaces for real-world applications. A design project will challenge students to plan their own designs, to develop interfaces and to integrate them into a working application prototype, to test their application with real users, and to effectively communicate the overall results. (Cross-listed with ISQA 3520)

**Prerequisite(s):** CIST 1300

**ISQA 8546 COMPUTER SECURITY MANAGEMENT (3 credits)**

The purpose of this course is to integrate concepts and techniques from security assessment, risk mitigation, disaster planning, and auditing to identify, understand, and propose solutions to problems of computer security and security administration. (Cross-listed with CIST 4540, CYBR 4540, CYBR 8546)

**Prerequisite(s):** CYBR 4360 or permission of the instructor.

**ISQA 8560 INFORMATION WARFARE AND SECURITY (3 credits)**

This course will study the nature of information warfare, including computer crime and information terrorism, as it relates to international, national, economic, organizational, and personal security. Information warfare policy and ethical issues will be examined.

**Prerequisite(s):** CIST 2100 or BSAD 8030 or ISQA 8030, or permission of instructor required.

**ISQA 8570 INFORMATION SECURITY POLICY AND ETHICS (3 credits)**

The course will cover the development and need for information security policies, issues regarding privacy, and the application of computer ethics. (Cross-listed with IASC 8570)

**Prerequisite(s):** CIST 2100 or BSAD 8030, or permission of instructor.

**ISQA 8580 SECURITY RISK MANAGEMENT AND ASSESSMENT (3 credits)**

The purpose of this course is to prepare the student for managing information security at the organizational level. This course will combine concepts from strategic management, decision science and risk analysis to prepare the student to integrate security issues into an organizational strategic planning process.

**Prerequisite(s):** CIST 2100 or ISQA 8030. Not open to non-degree graduate students.

**ISQA 8600 FROM DATA TO DECISIONS (3 credits)**

This course focuses on inquiry-driven data preparation and exploratory analysis skills for audience-driven, decision-oriented data analysis. Students gain experience in data evaluation, cleaning, documentation, and exploration with basic descriptive statistics and visualizations.

**ISQA 8700 DATA MINING: THEORY AND PRACTICE (3 credits)**

This course provides students theoretical issues as well as practical methods for conducting data mining process, including the implementation of a warehouse. After covering the essential concepts, issues, techniques to build an effective data warehouse, this course emphasizes the various techniques of data mining, such as association, classification, clustering and prediction for on-line analyses within the framework of data warehouse architectures. This course also promotes students to conduct a real-life data analyzing project in Big Data Era.

**Prerequisite(s):** ISQA 8050 and ISQA 8310 and ISQA 8040, not open to non-degree graduate students.

**ISQA 8720 APPLIED STATISTICAL MACHINE LEARNING (3 credits)**

This course focuses on advanced techniques in the analysis and evaluation of data, using both supervised and unsupervised methods. It covers the main types of statistical learning models needed for complex data analytics problems, as well as aspects of model development and optimization. Topics include: Linear and Non-Linear Regression Models, Classification, Resampling Methods, Model Selection and Regularization, Decision Trees, Model Boosting and Bagging, Support Vector Machines, and Clustering methods. This is an applied, hands-on course that will use a state-of-the-art statistical tool to implement the discussed approaches in assignments and a course project and focuses on the understanding and application of the concepts.

**Prerequisite(s):** ISQA 8156 (B-grade or better) and the following topics: The equivalent of two classes of statistics and/or advanced mathematics and a minimum of one semester of applying R in courses and/or projects

**ISQA 8736 DECISION SUPPORT SYSTEMS (3 credits)**

This course examines a set of information systems which specifically support managerial decision makers: Decision Support Systems, Group Decision Support Systems, Executive Information Systems, Data Warehouses, Expert Systems, and Neural Networks. This course explores the development, implementation, and application of these systems, how these systems can be applied to current business problems, as well as how organizational issues impact the implementation and usage of these systems. (Cross-listed with ISQA 4730)

**Prerequisite(s):** ISQA 8030 or equivalent.

**ISQA 8750 STORYTELLING WITH DATA (3 credits)**

This course provides an in-depth study of how to build a compelling story using data for business professionals to make winning arguments, it provides an overview of a number of technologies and research disciplines that enabled the power of data visualization. Data visualization is critical to managing large volumes of data, and can be defined as the science (analytical) and art (design) of manipulating and presenting data for expression and cognitive recognition. Data visualization involves using data in a way that humans can clearly understand, supporting efforts by organization to gain competitive advantage by changing operations, decision-making, and strategic initiatives.

**Prerequisite(s):** CSCI 1620 or equivalent. Admission into the UNO graduate program, basic web development or work experience with comparable grounding in programing, scripting concepts & technologies and permission by the instructor is needed.

**ISQA 8810 INFORMATION TECHNOLOGY PROJECT FUNDAMENTALS (3 credits)**

The course will integrate concepts and techniques from management science, psychology, organizational behavior, & administration change to identify, understand & propose solutions to the problems of project management. The purpose of the course is to prepare the graduate for project participation and leadership.

**Prerequisite(s):** CIST 2100 and ISQA 8040. Not open to non-degree graduate students.

**ISQA 8820 PROJECT RISK MANAGEMENT (3 credits)**

This course will cover project risk management, i.e., the process of measuring or assessing risk in projects and then developing strategies to manage the risk. The topics covered will include: Risk Management Planning, Risk Identification, Quantitative Risk Analysis, Qualitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control will be covered in detail. Students will learn how to apply and use the tools and techniques needed to perform these project management tasks. A collection of readings on risk management from the empirical literature coupled with risk management standards from organizations such as IEEE and the Project Management Institute (PMI) will be used to provide the student with an excellent foundation in risk management and control.

**Prerequisite(s):** ISQA 8810 or permission of instructor.

**ISQA 8900 INDEPENDENT RESEARCH IN MANAGEMENT INFORMATION SYSTEMS (1-3 credits)**

The content of the course will vary. However, both the student and the faculty member must sign an Independent Research Agreement and file it with the Master of Science in Management Information Systems Graduate Program Committee before registration for the course. This agreement will detail the project, the schedule for its completion, the form of the output, the method of evaluation and other relevant information pertaining to the project.

**Prerequisite(s):** Permission of instructor, and at least 12 hours of course work toward a M.S. in MIS should be completed.

**ISQA 8910 INFORMATION SYSTEMS INTERNSHIP (1-3 credits)**

Information Systems Internship provides students with an opportunity for practical application and further development of knowledge and skills acquired in the MS MIS degree program. The internship gives students professional work experience and exposure to the challenges and opportunities faced by IT professionals in the workplace.

**Prerequisite(s):** Permission of the instructor required. Students must have completed a minimum of 18 credit hours towards the MS MIS program. Not open to non-degree graduate students.

**ISQA 8950 CAPSTONE MANAGEMENT INFORMATION SYSTEMS (3 credits)**

The course consists of a student executed Information Systems design project providing an in-depth practical experience. It typically covers system conceptualization, analysis, and design. It may also involve prototyping. The project will typically not include the actual implementation of the system. This course replaces the MS in MIS comprehensive exam requirement.

**Prerequisite(s):** Students must have 6 credit hours or fewer left in the program. Students must have completed all core classes. Not open to non-degree graduate students.

**ISQA 8990 THESIS (1-6 credits)**

This course is a research project designed and executed under supervision of a thesis supervisory committee. Student will develop skills, including the ability to design, conduct, analyze, and report results in writing (i.e., thesis) of an original, independent, scientific investigation. The student's thesis supervisory committee must approve the project plan.

**Prerequisite(s):** ISQA 8060 research methods or equivalent. Graduate major in MIS and approval of the thesis supervisory committee. Not open to non-degree graduate students.

**ISQA 9010 FOUNDATIONS OF INFORMATION SYSTEMS RESEARCH (3 credits)**

This course covers the following areas: (1) information systems as an academic discipline including classic readings in IS and its reference disciplines, (2) theory development and evaluation, (3) research methods applicability in IS.

**Prerequisite(s):** Doctoral student standing in the information systems areas or with the permission of the instructor; ISQA 8060 or equivalent. Not open to non-degree graduate students.

**ISQA 9020 TECHNICAL AND PROCESS ISSUES IN INFORMATION SYSTEMS RESEARCH (3 credits)**

This seminar is a survey course on the technical and process issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in technical and process issues with the application of that knowledge to research on information systems. Major topics include: software engineering, programming, data base systems, decision support systems, data warehousing and mining systems, object-oriented systems, adaptive and expert systems, client-service systems, information filtering and multimedia systems, information agents, mobile computing, telecommunications, and electronic commerce.

**Prerequisite(s):** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree graduate students.

**ISQA 9030 BEHAVIORAL AND ORGANIZATIONAL ISSUES IN INFORMATION SYSTEMS (3 credits)**

This seminar is a survey course on behavioral and organizational issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in behavioral and organizational issues with the application of that knowledge to research on information systems. The course is intended for doctoral students in Information Technology or related areas.

**Prerequisite(s):** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree graduate students.

**ISQA 9120 APPLIED EXPERIMENTAL DESIGN AND ANALYSIS (3 credits)**

Constructing and analyzing designs for experimental investigations; completely randomized, randomized complete block and Latin-square designs, split-plot designs, incomplete block designs, confounded factorial designs, nested designs, and treatment of missing data, comparison of designs. The course will use computer-assisted analysis and graphic techniques included in software such as Statistical Analysis Software (SAS) or Statistical Package for Social Sciences (SPSS) or R (a programming language that provides a wide variety of statistical and graphical techniques. Similar to the S language).

**Prerequisite(s):** ISQA 4150 or ISQA 8156 or consent of instructor. Not open to non-degree graduate students.

**ISQA 9130 APPLIED MULTIVARIATE ANALYSIS (3 credits)**

The use of multivariate analysis for solving business problems. Multivariate Analysis of Variance (MANOVA), factor, cluster, and discriminant analysis techniques in IT research. The course will use computer-assisted analysis and graphic techniques included in software such as Statistical Analysis Software (SAS) or Statistical Package for Social Sciences (SPSS) or R (A programming language that provides a wide variety of statistical and graphical techniques. Similar to the S language).

**Prerequisite(s):** ISQA 4150 or ISQA 8156 or consent of instructor. Not open to non-degree graduate students.

**ISQA 9150 RESEARCH IN INFORMATION TECHNOLOGY (3 credits)**

Research methods in Information Technology involves an overview of the research process specific to problems in IT. Students will learn about theories in IT relevant to their areas of research. They will identify key components of research problems in IT, understand different types of research processes, develop research questions, and design research projects. They will learn to construct research instruments that enable them to collect data. They will also learn about the different data collection and analysis tools and techniques. As part of this course, students will take the CITI training and achieve the research readiness they need to succeed in the PhD in IT program.

**Prerequisite(s):** Permission of the instructor. Not open to non-degree graduate students.

**ISQA 9900 ADVANCED RESEARCH IN INFORMATION SYSTEMS (3 credits)**

This course provides a format for exploration of advanced research areas that are of interest to doctoral students in the information systems and/or information technology area. The specific research area will vary from semester to semester, in keeping with research interests of faculty and students. Examples of areas include, but are not limited to, e-business technology, mobile commerce, intelligent agents e-enabled decision support, electronic collaboration, computer-mediated communications, human-computer interaction and information assurance.

**Prerequisite(s):** Admission to PhD program in Information Technology or permission of instructor



**MATH 8016 INTRODUCTION TO THE THEORY OF RECURSIVE FUNCTIONS (3 credits)**

This is a proof-oriented course presenting the foundations of Recursion Theory. We present the definition and properties of the class of primitive recursive functions, study the formal models of computation, and investigate partially computable functions, universal programs. We prove Rice's Theorem, the Recursion Theorem, develop the arithmetic hierarchy, demonstrate Post's theorem. Introduction to the formal theories of computability and complexity is also given. (Cross-listed with CSCI 4010, CSCI 8016, MATH 4010).

**Prerequisite(s):** MATH 2230 or MATH 2030 with a C- or better or CSCI 3660 with a C- or better or instructor's permission.

**MATH 8036 MODERN ALGEBRA (3 credits)**

Algebra is the study of mathematical manipulations that preserve something (like equality - when solving equations). The areas in which Algebra finds application are quite diverse, from Ancient Greek Geometry through to Modern Information Protection and Security (error correcting codes, data compression, and cryptography). This course begins with topics that should be familiar (such as ruler-and-compass constructions, and modular arithmetic) and builds upon this foundation through polynomial rings up to finite fields and basic group theory. (Cross-listed with MATH 4030).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better

**MATH 8050 ALGORITHMIC GRAPH THEORY (3 credits)**

The overall of the goal is to introduce advanced concepts in graph theory, graph modeling, and graph algorithms and how they can be used to solve a wide range of problems in various application domains. The course introduces students to several applied path algorithms, clustering and partitioning techniques, network flow algorithms, and weighted matching algorithms. Other advanced concepts associated with complex networks include node centralities in graphs and community detection approaches. The course will also introduce students to key classes of graphs with a particular focus on the main classes of Perfect Graphs and their applications in scheduling, chip design, mobile computing, and Biomedical Informatics. (Cross-listed with CSCI 8050).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and MATH 4150 or MATH 8156 or permission of instructor. Not open to non-degree graduate students.

**MATH 8056 LINEAR ALGEBRA (3 credits)**

Linear algebra is extensively utilized in the mathematical modeling of many natural phenomena. Many scientific and engineering disciplines, such as data science, chemical engineering and biology, make extensive use of the theory and techniques commonly present in basic to advanced linear algebra courses. The goal of this course is to help students to grasp a solid theoretical understanding of vectors, vector spaces, inner product spaces, linear transformations, eigenvalues, canonical forms, complex vectors, matrices, and orthogonality. By going through the materials in a mathematically rigorous way, students will develop deeper and more accurate intuitions of the basic concepts in linear algebra. Consequently, the applications of linear algebra will become much more transparent. (Cross-listed with MATH 4050).

**Prerequisite(s):** MATH 2050 with a grade of C- or better; MATH 2030 or MATH 2230 or equivalent with a grade of C- or better; or permission

**MATH 8060 ALGORITHMIC COMBINATORICS (3 credits)**

This course includes classical combinatorial analysis graph theory, trees, network flow, matching theory, external problems, and block designs. (Cross-listed with CSCI 8060).

**Prerequisite(s):** MATH 3100, CSCI 3100, MATH 8105 or CSCI 8105 or instructor's permission.

**MATH 8080 DESIGN AND ANALYSIS OF ALGORITHMS (3 credits)**

The course provides students an understanding of advanced topics in algorithms. Main topics include: growth of functions, asymptotic notation, recurrences, divide and conquer, dynamic programming, greedy algorithms, graph algorithms, and the theory of NP-Completeness. (Cross-listed with CSCI 8080).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 or equivalent. Not open to non-degree graduate students.

**MATH 8105 APPLIED COMBINATORICS (3 credits)**

Basic counting methods, generating functions, recurrence relations, principle of inclusion-exclusion. Polya's formula. Elements of graph theory, trees and searching network algorithms. (Cross-listed with CSCI 3100, CSCI 8105, MATH 3100).

**MATH 8116 ABSTRACT ALGEBRA I (3 credits)**

An introduction to group theory. Various classes of group are studied: symmetric groups, abelian, cyclic, and permutation groups. Basic tools are developed and used: subgroups, normal subgroups, cosets, the Lagrange theorem, group homomorphisms, quotient groups, direct products, and group actions on a set. The course culminates with the Sylow theorems in finite group theory. The theory is illustrated with examples from geometry, linear algebra, number theory, crystallography, and combinatorics. (Cross-listed with MATH 4110).

**Prerequisite(s):** MATH 4050/MATH 8056 with a C- or better or MATH 4560/MATH 8566 with a C- or better or permission of instructor

**MATH 8126 ABSTRACT ALGEBRA II (3 credits)**

An introduction to ring and field theory. Various classes of commutative rings are considered including polynomial rings, and the Gaussian integers. Examples of fields include finite fields and various extensions of the rational numbers. Concepts such as that of an ideal, integral domain, characteristic and extension field are studied. The course culminates with an introduction to Galois theory. Applications include the resolution of two classical problems: the impossibility of angle-trisection and the general insolubility of polynomial equations of degree 5 or higher. (Cross-listed with MATH 4120)

**Prerequisite(s):** MATH 4110/MATH 8116 with a C- or better or permission of instructor

**MATH 8156 GRAPH THEORY & APPLICATIONS (3 credits)**

Introduction to graph theory. Representations of graphs and graph isomorphism. Trees as a special case of graphs. Connectivity, covering, matching and coloring in graphs. Directed graphs and planar graphs. Applications of graph theory in several fields such as networks, social sciences, VLSI, chemistry and parallel processing. (Cross-listed with CSCI 4150, CSCI 8156, MATH 4150).

**Prerequisite(s):** MATH 2030 or permission of instructor.

**MATH 8206 NUMERICAL ANALYSIS (3 credits)**

This course involves solving nonlinear algebraic equations and systems of equations, interpolation and polynomial approximation, numerical differentiation and integration, numerical solutions to ordinary differential equations, analysis of algorithms and errors, and computational efficiency. (Cross-listed with CSCI 4200, CSCI 8206, MATH 4200).

**Prerequisite(s):** MATH 1970 and MATH 2050 and MATH 2350 with a C- or better or permission of instructor.

**MATH 8235 INTRODUCTION TO ANALYSIS (3 credits)**

This course provides a theoretical foundation for the concepts of elementary calculus. Topics include real number system, topology of the real line, limits, functions of one variable, continuity, differentiation. (Cross-listed with MATH 3230).

**Prerequisite(s):** MATH 1960 and MATH 2230 each with a grade of C- or better.

**MATH 8236 MATHEMATICAL ANALYSIS I (3 credits)**

Provides a theoretical foundation for the concepts of classical calculus. Topics include ordered fields, the real and complex number system, basic metric space topology, numerical sequences and series, limits and continuity in metric spaces, monotonic functions, differentiation, (functions of several variables included). (Cross-listed with MATH 4230).

**Prerequisite(s):** MATH 3230/MATH 8235 or equivalent with a grade of C- or better.

**MATH 8246 MATHEMATICAL ANALYSIS II (3 credits)**

Provides a theoretical foundation for the concepts of classical Calculus (vector calculus included). Topics include sequences and series of functions, uniform convergence, power series, Fourier series, multivariable real differential and integral calculus, the Implicit Function Theorem, integration of different forms, and the important formulas, connecting those integrals, due to: Green, Gauss, Riemann, and Ostrogradski. (Cross-listed with MATH 4240).

**Prerequisite(s):** MATH 4230/MATH 8236 with a grade of C- or better.

**MATH 8250 PARTIAL DIFFERENTIAL EQUATIONS (3 credits)**

Partial differential equations (PDEs) are fundamental in the application of mathematics to science and engineering. Topics to be covered will include: Linear and nonlinear first-order equations, classification of second-order linear equations, elliptic, hyperbolic and parabolic equations and boundary value problems, and Green's functions.

**Prerequisite(s):** MATH 1970, MATH 2350, or instructor's permission. MATH 4330/MATH 8336 is recommended, but not required.

**MATH 8255 INTRODUCTION TO NUMERICAL METHODS (3 credits)**

This course emphasizes the implementation of several numerical methods to problems that arise in science and engineering. It involves the application of the computer to solve mathematical problems using the following computational techniques: Taylor Series approximation, numerical differentiation, root-finding methods, interpolation, extrapolation, curve fitting, solution methods for matrix equations, numerical differentiation, numerical integration, and the solution of differential equations. (Cross-listed with MATH 3250).

**Prerequisite(s):** MATH 1960 with a C or better.

**MATH 8276 COMPLEX ANALYSIS (3 credits)**

This course is an introduction to the theory of functions of a complex variable, a fundamental area of mathematics with multiple applications to science and engineering. Topics include the field of complex numbers, complex differentiation, the complex contour integral and Cauchy's integral formula, Taylor expansions and analytic functions, conformal mapping and Riemann's conformal equivalence theorem, residue theory and Laurent series, harmonic functions, and applications. (Cross-listed with MATH 4270).

**Prerequisite(s):** MATH 3230/MATH 8235 with a grade of C- or better or permission of the instructor.

**MATH 8306 DETERMINISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of deterministic operations research models and algorithms. Topics include linear programming, network programming, and integer programming. (Cross-listed with CSCI 4300, CSCI 8306, MATH 4300).

**Prerequisite(s):** MATH 2050 with a C- or better or permission of instructor.

**MATH 8316 PROBABILISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of probabilistic operations, research models and algorithms. Topics include Markov chains, queueing theory, inventory models, forecasting, and simulation. (Cross-listed with CSCI 4310, CSCI 8316, MATH 4310).

**Prerequisite(s):** MATH 2050 and either MATH 4740 or MATH 8746 or STAT 3800 or STAT 8805 all with a C- or better or permission of instructor.

**MATH 8326 COMPUTATIONAL OPERATIONS RESEARCH (3 credits)**

Survey of computational methods used in the solution of operations research problems. Some topics may include scripting to guide optimization software, constraint programming, heuristics and metaheuristics for optimization, basic machine learning algorithms, and simulation. (Cross-listed with MATH 4320, CSCI 4320, CSCI 8326).

**Prerequisite(s):** MATH 3200 or CSCI 1620, and MATH 4300 each with a grade of C- or better or permission of instructor.

**MATH 8336 INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS (3 credits)**

This course introduces the basic methods of PDEs guided by applications in physics and engineering. The main topics to be covered include The Linear First order PDEs, Transport equations, Characteristics, Classification of PDEs, Separation of variables, Heat conduction, vibrating membranes, boundary value problems, Maximum principle, Sturm-Liouville problems, Fourier series, Fourier integrals, Harmonic functions, Legendre polynomials, Distributions, Green's functions. (Cross-listed with MATH 4330).

**Prerequisite(s):** MATH 1970 with a C- or better and MATH 2350 with a C- or better, or permission of instructor; MATH 2050 recommended, not required.

**MATH 8356 ORDINARY DIFFERENTIAL EQUATIONS (3 credits)**

This course covers the theory of initial-, boundary-, and eigenvalue problems, existence theorems, real and complex linear systems of differential equations, and stability theory. There will be a strong emphasis on methods for finding solutions of initial and boundary value problems and analyzing properties of these solutions for various ordinary differential equations. (Cross-listed with MATH 4350).

**Prerequisite(s):** MATH 1970 with a C- or better, MATH 2050 with a C- or better, and MATH 2350 with a C-, or better or instructor's permission.

**MATH 8400 DYNAMICAL SYSTEMS AND CHAOS (3 credits)**

Review of difference equations and differential equations, stability theory, periodic orbits, bifurcations, Lyapunov exponents, fractals, chaotic orbits, and chaotic attractors.

**Prerequisite(s):** Permission from Instructor (If you have a background that covers introduction to analysis, differential equations, linear algebra, and you are somewhat familiar with computer codes, it is easy to obtain permission.)

**MATH 8406 THE FINITE ELEMENT METHOD (3 credits)**

Introduction to finite elements methods for solving ordinary and partial differential equations. Theoretical foundations of finite element methods for boundary value problems, approximation by piecewise polynomial functions, variation formulation of partial differential equations, basic error estimates. The Rayleigh-Ritz-Galerkin method, convergence of approximations, time-dependent problems, error analysis, discretization and computer implementation, applications to problems in elasticity, heat transfer, and fluid mechanics. (Cross-listed with MATH 4400).

**Prerequisite(s):** MATH 1970, MATH 2050 and MATH 2350 all with a C- or better or instructor permission. MATH 3300/MATH 8305 and MATH 4330/MATH 8336 recommended. Students should be able to use a programming language (ie MATLAB) to complete computational assignments

**MATH 8410 BOOLEAN NETWORKS (3 credits)**

This course is focused on introduction to discrete dynamical networks, in particular logical networks, and their applications.

**Prerequisite(s):** MATH 1960 (Calculus II), MATH 2230 (proof writing skills), MATH 4740 or equivalent (basic probability theory), basic computer skills; or permission of the instructor.

**MATH 8430 LINEAR PROGRAMMING (3 credits)**

This course includes a complete development of theoretical and computational aspects of linear programming. Basic theoretical foundations covered include polyhedra, convexity, linear inequalities and duality. Advanced topics such as decomposition and column generation are covered. Both simplex methods and interior point methods are included.

**Prerequisite(s):** MATH 4300/MATH 8306

**MATH 8440 NETWORK PROGRAMMING (3 credits)**

A presentation of network flow models and optimization algorithms. Topics include pure, generalized, integer, and constrained network problems, plus special cases of each, including transportation, assignment, shortest-path, transshipment, and multicommodity.

**Prerequisite(s):** MATH 4300/MATH 8306

**MATH 8456 INTRODUCTION TO MACHINE LEARNING AND DATA MINING (3 credits)**

This is an introduction to machine learning and data mining which covers the following topics with an emphasis on mathematical and statistical analysis: linear and nonlinear regression models, model selection and regularization methods, resampling methods, classification models, tree-based models, and unsupervised learning topics. If time allows, text mining and deep learning will also be introduced in the course. Statistical software will be used. (Cross-listed with MATH 4450, STAT 4450, STAT 8456)

**Prerequisite(s):** MATH 4740/8746 with a C- or better or STAT 3800/8805 with a C- or better or permission of instructor.

**MATH 8460 INTEGER PROGRAMMING (3 credits)**

Advanced study in mathematical programming with integer or mixed integer variables. Topics include integer programming, modeling, applications of integer programming, and exploration of solution algorithms based on linear programming and heuristic methods such as tabu search, simulated annealing, and genetic algorithms.

**Prerequisite(s):** MATH 4300/CSCI 4300/MATH 8306/CSCI 8306. Not open to non-degree graduate students.

**MATH 8480 MULTI-AGENT SYSTEMS AND GAME THEORY (3 credits)**

This course covers advanced topics in the area of coordination of distributed agent-based systems with a focus on computational aspects of game theory. The main topics covered in this course include distributed constraint satisfaction, distributed constraint optimization, and competitive and cooperative game theory. (Cross-listed with CSCI 8480).

**Prerequisite(s):** CSCI 4450 or CSCI 8456. Suggested background courses: CSCI 4480 or CSCI 8486; CSCI 8080. Not open to non-degree graduate students.

**MATH 8500 NUMERICAL LINEAR ALGEBRA (3 credits)**

Topics covered in this course include error propagation, solutions of nonlinear equations, solutions of linear and nonlinear systems by various schemes, matrix norms and conditioning, and computation of eigenvalues and eigenvectors. (Cross-listed with CSCI 8500).

**Prerequisite(s):** MATH 1960 and MATH 2050, or permission of instructor. Familiarity with computer programming is assumed.

**MATH 8510 NUMERICAL DIFFERENTIAL EQUATIONS (3 credits)**

Topics covered in this course include interpolation and approximations, numerical differentiation, numerical integration, and numerical solutions of ordinary and partial differential equations. (Cross-listed with CSCI 8510).

**Prerequisite(s):** MATH 1970, MATH 2350, or permission of instructor. Familiarity with computer programming is assumed.

**MATH 8520 ADVANCED TOPICS IN OPERATIONS RESEARCH (3 credits)**

Advanced treatment of a specific topic in the area of operations research not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with CSCI 8520).

**Prerequisite(s):** MATH 4300 or MATH 8306 or CSCI 4300 or CSCI 8306 or permission of the instructor.

**MATH 8566 NUMBER THEORY & CRYPTOGRAPHY (3 credits)**

An overview of one of the many beautiful areas of mathematics and its modern application to secure communication. The course is ideal for any student who wants a taste of mathematics outside of, or in addition to, the calculus sequence. Topics to be covered include: prime numbers, congruences, perfect numbers, primitive roots, quadratic reciprocity, sums of squares, and Diophantine equations. Applications include error-correcting codes, symmetric and public key cryptography, secret sharing, and zero knowledge proofs. (Cross-listed with CSCI 4560, CSCI 8566, MATH 4560).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better or CSCI 2030 with a C- or better or permission of instructor

**MATH 8616 INTRODUCTION TO TOPOLOGY (3 credits)**

This is a proof-oriented course presenting the foundations of topology. Metric spaces and general topological spaces are introduced. The course explores the properties of connectedness, compactness and completeness, and operations of Tychonoff product and hyperspace. (Cross-listed with MATH 4610).

**Prerequisite(s):** MATH 3230/8235 with a C- or better or permission of instructor.

**MATH 8620 GENERAL TOPOLOGY (3 credits)**

General topology has roots in geometry and analysis through the study of spaces, dimensions, and transformations. Its development was influenced by the parallel development of (axiomatic) set theory. This course introduces topological spaces from the point of view of separation axioms, countability axioms, compactifications, Baire property, and other completeness properties. Basic concepts of Descriptive Set Theory are also introduced.

**Prerequisite(s):** MATH 4610/8616 or permission of instructor.

**MATH 8626 ITERATED FUNCTION SYSTEMS AND FRACTALS (3 credits)**

This is a proof-oriented course presenting the foundations of fractal geometry. It introduces students to the beauty, magic, and applications of fractals and iterated function systems, with emphasis on the mathematics behind it all. Topics range from contractions on hyperspaces and their fixed points to fractal dimensions to Julia and Mandelbrot sets. (Cross-listed with MATH 4620).

**Prerequisite(s):** MATH 8616 with a C or better or permission of instructor.

**MATH 8645 MODERN GEOMETRY (3 credits)**

This course will study the modern foundations of Euclidean and Non-Euclidean Geometry. Included will be a study of the principles of axiomatic systems. Euclidean Geometry will be investigated using Hilbert's axioms for Euclidean geometry (or another equivalent Euclidean geometry axiom set). Hyperbolic geometry will be encountered through the models of Klein and Poincare. Neutral geometry with Lambert and Saccheri quadrilaterals will be studied. Finite geometries and projective geometries will also be explored. (Cross-listed with MATH 3640).

**Prerequisite(s):** MATH 2230 with a grade of C- or better.

**MATH 8650 INTRODUCTION TO PROBABILITY MODELS (3 credits)**

This is an introduction to probability modeling including Poisson Processes, Markov chains, birth-death processes, queueing models and renewal theory. Applications will be an important part of the course.

**Prerequisite(s):** MATH 4740/MATH 8746 or STAT 3800/STAT 8805 or permission of instructor.

**MATH 8666 AUTOMATA, COMPUTABILITY, AND FORMAL LANGUAGES (3 credits)**

This course presents a sampling of several important areas of theoretical computer science. Definition of formal models of computation and important properties of such models, including finite automata and Turing machines. Definition and important properties of formal grammars and their languages. Introduction to the formal theories of computability and complexity. (Cross-listed with CSCI 4660, CSCI 8666, MATH 4660).

**Prerequisite(s):** MATH 2030. Recommended: CSCI 3320/CSCI 8325.

**MATH 8670 TOPICS IN PROBABILITY AND STATISTICS (3 credits)**

Advanced treatment of a specific topic in the area of probability and/or statistics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with STAT 8670).

**Prerequisite(s):** MATH 4750/MATH 8756 or STAT 3800/STAT 8805 or permission from instructor

**MATH 8720 RELIABILITY THEORY (3 credits)**

This course covers the probabilistic and statistical aspects of reliability theory. Reliability theory is concerned with the probability that a component or system is successfully working over a given time period or at a specific time instance. (Cross-listed with STAT 8720).

**MATH 8746 INTRODUCTION TO PROBABILITY AND STATISTICS I (3 credits)**

A mathematical introduction to probability theory including the properties of probability; probability distributions; expected values and moments; specific discrete and continuous distributions; and transformations of random variables. (Cross-listed with MATH 4740).

**Prerequisite(s):** MATH 1970 and either MATH 2230 or MATH 2030 all with a grade of C- or better or permission of instructor.

**MATH 8756 INTRODUCTION TO PROBABILITY AND STATISTICS II (3 credits)**

Theory and methods of statistical inference including sampling distributions, estimators, estimation, and statistical hypotheses. (Cross-listed with MATH 4750).

**Prerequisite(s):** MATH 4740/MATH 8746 with a grade of C- or better.

**MATH 8766 TOPICS IN APPLIED MATHEMATICS (3 credits)**

Selection of such topics such as dynamical systems and chaos, Boolean networks, modeling of discrete or continuous systems, matrix theory, difference equations, information theory, discrete events simulation and other approved by Upper Curriculum Committee. (Cross-listed with MATH 4760).

**Prerequisite(s):** MATH 3100/CSCI 3100 with a grade of C- or better, or permission of instructor.

**MATH 8855 HISTORY OF MATHEMATICS (3 credits)**

An overview of the history of mathematics and famous mathematicians via studying and solving famous mathematical problems, exploring famous mathematical theorems, and studying the biographies of famous mathematicians. (Cross-listed with MATH 3850).

**Prerequisite(s):** MATH 1950 with a grade of C- or higher and one of either MATH 2230 or MATH 2000 with a grade of C- or higher.

**MATH 8956 TOPICS IN THEORETICAL MATHEMATICS (3 credits)**

This course introduces students to a specialized subject matter in the areas of theoretical mathematics not covered in existing courses. The course may be repeated for different topics up to a maximum of six credit hours. The specific topics will vary, depending upon when the course is offered. One example of a course is Axiomatic Set Theory. (Cross-listed with MATH 4950).

**Prerequisite(s):** Permission of instructor.

**MATH 8960 MASTER'S PROJECT (1-6 credits)**

An applied project, designed and executed under the supervision of both a faculty and industry advisor. In the project the student will apply their mathematical and/or statistical skills to an applied problem. The student will present their results via a written report and oral presentation. (Cross-listed with STAT 8960).

**Prerequisite(s):** Permission of faculty advisor and graduate program chair. Not open to non-degree graduate students.

**MATH 8970 INDEPENDENT GRADUATE STUDIES (1-3 credits)**

Under this number a graduate student may pursue studies in an area that is not normally available to him/her in a formal course. The topics studied will be a graduate area in mathematics to be determined by the instructor.

**Prerequisite(s):** Permission of instructor and graduate classification.

**MATH 8980 GRADUATE SEMINAR (3 credits)**

A graduate seminar in mathematics offering coverage of advanced areas of mathematics. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** Permission of the Instructor.

**MATH 8990 THESIS (1-6 credits)**

An independent research project, written under the supervision of a graduate adviser in the department of mathematics. Approval of the topic and the completed project by thesis committee is required.

**Prerequisite(s):** Approval of the topic and the completed project by thesis committee is required.

**MATH 9110 ADVANCED TOPICS IN APPLIED MATHEMATICS (3 credits)**

Advanced treatment of a specific topic in the area of applied mathematics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ.

**Prerequisite(s):** Permission of instructor.

**MATH 9230 THEORY OF FUNCTION OF REAL VARIABLES (3 credits)**

A theoretical foundation for the concepts of measure theory and integration on a measure space as developed by Henry Leon Lebesgue (followed by others) starting the first decade of the 20th century including a comparison with Riemann's classical construction of integration theory known from classical calculus. Topics include: Real number system, convergence, continuity, bounded variation, differentiation, Lebesgue-Stieltjes integration, abstract measure theory, and the  $L_p$  spaces.

**Prerequisite(s):** MATH 4230/MATH 8236 or permission of the instructor

**STAT 8005 STATISTICAL METHODS I (3 credits)**

An introduction to descriptive statistics, measures of central value and dispersion, probability and distributions, population and sample, simple linear regression, statistical inference: point estimation, confidence intervals, hypotheses testing, two population comparison, goodness-of-fit tests, analysis of variance. Statistical software like Minitab or Excel will be utilized in the course. (Cross-listed with STAT 3000).

**Prerequisite(s):** MATH 1220 or MATH 1300 or MATH 1320 or equivalent with a grade of C- or better, or permission of instructor

**STAT 8416 INTRODUCTION TO DATA SCIENCE (3 credits)**

Topics covered in this course include Data Technology, Methods of gathering and cleaning structured or unstructured data, Exploratory data analysis & Dynamic and interactive data visualization, Modeling data for prediction, forecasting or classification. (Cross-listed with STAT 4410).

**Prerequisite(s):** MATH 4740 with a C- or better or concurrent; or STAT 3800 with a C- or better or concurrent; or permission of instructor. Students should be comfortable with computer programming & have knowledge of data structures & preliminary statistical methods.

**STAT 8426 EXPLORATORY DATA VISUALIZATION AND QUANTIFICATION (3 credits)**

Topics covered in this course include Exploratory Data Visualization for categorical/qualitative single/multivariate data, Grammar of Graphics, Organizing Data for Visualization, Methods of Displaying Data that include dynamic and interactive visualization, Visual Diagnostics of Statistical Models and Visual Statistical Inference. Students planning to enroll in this course should be comfortable with computer programming and have knowledge of data structures and preliminary statistical methods. (Cross-listed with STAT 4420)

**Prerequisite(s):** STAT 3800 or STAT 8805 or MATH 4740 or MATH 8746 with a grade of C- or better or another introductory probability/statistics course with a grade of C- or better, and MATH 3200 or CSCI 1620 with a grade of C- or better, or permission of instructor.



**STAT 8436 LINEAR MODELS (3 credits)**

This is an introduction to linear statistical models which will include: simple linear regression models, multiple linear regression models, ANOVA models including one way ANOVA, randomized block design, and other designs. Also, logistic regression models, Poisson regression models, bootstrapping/resampling models, survival analysis. Some necessary linear algebra and mathematical statistics ideas will be covered in the course also. If time allows, some mixed models and/or survival models. Much use of computer software will be made. (Cross-listed with STAT 4430)

**Prerequisite(s):** MATH 4750 or MATH 8756 w/ a grade of C- or better or STAT 3800 or STAT 8805 w/ a C- or better or instructor permission based on students' having taken a basic statistics course w/ a grade of C- or better & having at least a basic knowledge of calculus.

**STAT 8446 TIME SERIES ANALYSIS (3 credits)**

The objective of this course is to learn and apply statistical methods for the analysis of data that have been observed over time. Topics covered include: Models for Stationary and Non-Stationary Time Series, Model Specification, Parameter Estimation, Model Diagnostics, Forecasting, Seasonal Models, Time Series Regression, and Spectral Analysis. Statistical software will be used. (Cross-listed with STAT 4440)

**Prerequisite(s):** MATH 4750 or MATH 8756 w/ a grade of C- or better or STAT 3800 or STAT 8805 w/ a C- or better or another introductory probability/statistics course w/ a C- or better, or permission of instructor.

**STAT 8456 INTRODUCTION TO MACHINE LEARNING AND DATA MINING (3 credits)**

This is an introduction to machine learning and data mining which covers the following topics with an emphasis on mathematical and statistical analysis: linear and nonlinear regression models, model selection and regularization methods, resampling methods, classification models, tree-based models, and unsupervised learning topics. If time allows, text mining and deep learning will also be introduced in the course. Statistical software will be used. (Cross-listed with MATH 4450, MATH 8456, STAT 4450)

**Prerequisite(s):** MATH 4740/8746 with a C- or better or STAT 3800/8805 with a C- or better or permission of instructor.

**STAT 8670 TOPICS IN PROBABILITY AND STATISTICS (3 credits)**

Advanced treatment of a specific topic in the area of probability and/or statistics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with MATH 8670).

**Prerequisite(s):** MATH 4750/MATH 8756 or STAT 3800/STAT 8805 or permission from instructor

**STAT 8700 BAYESIAN STATISTICS (3 credits)**

The objective of this course is to introduce the Bayesian approach to statistical inference. Topics covered include: Review of probability, Bayes theorem, and Likelihood; The Bayesian methodology, prior and posterior distributions; Choices of prior distribution, conjugate and Jeffreys priors; Credible intervals and inference; Bayesian computation - Markov Chain Monte Carlo and the Gibbs Sampler; Hierarchical models; Regression models.

**Prerequisite(s):** MATH 8756 or equivalent or permission of instructor.

**STAT 8710 DESIGN AND ANALYSIS OF EXPERIMENTS (3 credits)**

Introduction to design and analysis of controlled experiments. The goal of experimental design is to be able to construct an experiment to identify which factors most impact the response and do so in an efficient manner. Statistical software will be used. Types of designs studied include: Randomized Block Designs, Latin Square Designs, Incomplete Block Designs, Factorial Designs, and Nested Designs.

**Prerequisite(s):** MATH 4750/8756 or permission of instructor.

**STAT 8720 RELIABILITY THEORY (3 credits)**

This course covers the probabilistic and statistical aspects of reliability theory. Reliability theory is concerned with the probability that a component or system is successfully working over a given time period or at a specific time instance. (Cross-listed with MATH 8720).

**Prerequisite(s):** Either MATH 4740 or STAT 3800 or permission of the instructor. Some basics of mathematical analysis are helpful when discussing limit theorems, but not required.

**STAT 8730 ADVANCED STATISTICAL MACHINE LEARNING (3 credits)**

This course will introduce machine learning models from a statistical perspective. Comparing to the introductory machine learning course, this course will focus more on (1) probability and statistical theory for machine learning methods; (2) relationship between machine learning and high-dimensional multivariate statistical analysis; (3) evolution and frontier of machine learning methods; (4) algorithm development for research purpose. Programming software will be used.

**Prerequisite(s):** MATH 4750/8756 with a C or better or permission of instructor.

**STAT 8805 APPLIED ENGINEERING PROBABILITY AND STATISTICS (3 credits)**

An introduction to the application of probability and statistics to engineering problems. Topics include: probability and probability distributions, mathematical expectation, distribution of random variables, binomial, Poisson, hypergeometric, gamma, normal, and t-distributions, Central Limit Theorem, confidence intervals, hypothesis testing. If time allows, some linear regression and contingency tables. Credit for both MATH 4740 and STAT 3800 will not be given. (Cross-listed with STAT 3800)

**Prerequisite(s):** MATH 1970

**STAT 8950 DATA SCIENCE CAPSTONE PROJECT (3 credits)**

The Data Science Capstone Project completes the Data Science Master (MS) student's graduate experience. Students will work on individual tasks and team-based activities on a real-world project. This course intends to provide experience in the industrial practice of real-world data science pipeline-building projects. Furthermore, this course allows MS students to integrate and improve the technical skills they learned throughout their graduate education and will enable them to enhance professional skills such as communication and teamwork. (Cross-listed with DSCI 8950).

**Prerequisite(s):** Complete all core courses of the MS Data Science program (STAT 8416, STAT 8426, ECON 8320, ECON 8310/BSAD 8080, ISQA 8206, ITIN 8300/ISQA 8060) and Permission from the Instructor. Not open to non-degree graduate students.

**STAT 8960 MASTER'S PROJECT (1-6 credits)**

An applied project, designed and executed under the supervision of both a faculty and industry advisor. In the project the student will apply their mathematical and/or statistical skills to an applied problem. The student will present their results via a written report and oral presentation. (Cross-listed with MATH 8960).

**Prerequisite(s):** Permission of faculty advisor and graduate program chair. Not open to non-degree graduate students.

**BIOI 8850 SPECIAL TOPICS IN BIOINFORMATICS (3 credits)**

This course is intended to provide a mechanism for offering instruction in subject areas that are not covered in other regularly scheduled courses. In general, courses offered under the BIOI 8850 designation will focus on evolving subject areas in bioinformatics.

**Prerequisite(s):** Course prerequisites of a specific offering of BIOI 8850 will be determined by the supervising faculty member and will be identified in the course proposal. It is anticipated that permission of the faculty member teaching the course will be required.

**BMI 8000 ADVANCES IN BIOMEDICAL INFORMATICS (0 credits)**

BMI 8000 provides a regular forum for BMI graduate students, where the latest developments in the field of Biomedical Informatics are introduced and discussed. The course also functions as a central communication and collaboration hub for graduate students in BMI. Participation is required.

**Prerequisite(s):** Students in the MS in BMI and PhD in BMI program may register. Not open to non-degree graduate students.

**BMI 8020 ADVANCED COURSE IN BIOINFORMATICS (3 credits)**

This is a special topics course designed to explore the research interests of faculty and students. Therefore, topics may include, but are not limited to, such areas of study as next-generational sequencing, biological networks, proteomics, metabolomics, and biomedical informatics.

**Prerequisite(s):** Admission to the MS/PhD Program in the College of Information Science and Technology, or permission of the instructor. Not open to non-degree graduate students.

**BMI 8070 HEALTH INFORMATICS RESEARCH METHODS (3 credits)**

This is a foundational course for health informatics research methods. Health informatics is a broad term that denotes disciplines that encompass the use of computer and information science to manage all aspects of healthcare data and the use of healthcare information to foster better collaboration among a patient's various healthcare providers. This course takes a practical approach to understanding health informatics research methods through the use of real-life examples, step-by-step research method practices, and applying various analytical procedures. The course will guide the student through the process of designing research studies using a variety of research methods. Students are introduced to quantitative, qualitative and mixed methods designs through hands-on assignments and reviewing selected research studies. In addition, students will learn how to conduct a literature review. Students will learn about grant opportunities, the proposal writing process and IRB applications.

**Prerequisite(s):** Graduate student status and prior or concurrent enrollment in BMI 8100, or by instructor approval.

**BMI 8080 SEMINAR IN BIOMEDICAL INFORMATICS (3 credits)**

This is a variable-content course that engages students in current research in Biomedical Informatics and develops skills in the oral and written presentation of scientific research.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**BMI 8100 INTRODUCTION TO BIOMEDICAL INFORMATICS (3 credits)**

This course offers students an overview of the field of biomedical informatics, combining perspectives from computing, biosciences and medicine. The historical development of the field and its influence on biological, clinical, and translational research will be discussed. Issues related to bioinformatics, clinical, bioimaging and public health/population informatics will be explored.

**Prerequisite(s):** Class standing of senior or above.

**BMI 8300 PUBLIC HEALTH GENOMICS (3 credits)**

This course will address the biopsychosocial issues that bridge genomics and public health, which are generally considered two vastly different disciplines. The focus will center on understanding how genomics may be incorporated into health promotion and disease prevention efforts for individuals and population.

**Prerequisite(s):** Class standing of senior or above.

**BMI 8310 ADVANCED HEALTH INFORMATICS (3 credits)**

The purpose of this course is to equip students with advanced skills in analyzing healthcare data using state-of-the-art frameworks, tools, and applications. Students will learn to effectively use medical and health data, interpret results from analyzing this data, and construct a cohesive story outlining their findings in a clinical environment. Upon completion of this course, students will be able to outline current trends in health informatics, summarize the legislative and ethical barriers present in the field, and recognize common standardizations used in health informatics. In addition, students will be able to apply state-of-the-art data analytics and visualization approaches to tackle health relevant problems, using real world data from the MIMIC IV dataset.

**Prerequisite(s):** BMI 8100 and ISQA 8156 or Permission of the instructor. Not open to non-degree graduate students.

**BMI 8320 CONSUMER HEALTH INFORMATION SYSTEMS (1 credit)**

Consumer health informatics as a field focuses on health informatics from the perspective of the consumer or patient, health literacy, and consumer education. Creative problem solving and fluency in this subdiscipline requires competence in information structures and processes that empower consumers to manage their own health. In this course, students will strategically review publicly available databases, datasets, and projects involved in consumer health. With this information in hand, students will design their own consumer health information system geared towards addressing a consumer or patient education and literacy challenge of their interest.

**BMI 8400 LINEAR ALGEBRA FOR ADVANCED COMPUTING AND AI (3 credits)**

Matrix Analysis and Linear Algebra are at the core of several important algorithms and techniques that are widely used in machine learning for data analytics, imaging informatics, and bioinformatics. The course will explore fundamental concepts of matrix analysis and linear algebra as they apply to machine learning, emphasizing applications over proofs. Students will have an opportunity to perform "pencil and paper" calculations as well as more sophisticated numerical computations using a programming language/statistical environment of their choice. Applications of linear algebra to machine learning in the context of imaging informatics and biomedicine will be covered in depth.

**Prerequisite(s):** Proficiency in programming and knowledge of calculus are required. Familiarity with concepts from biology is beneficial but not required.

**BMI 8540 FOUNDATIONS IN PROGRAMMING FOR BIOMEDICAL INFORMATICS (3 credits)**

Foundations in programming, software development, pipeline management, and version control are critical for developing a capable biomedical informatics workforce. This course will provide foundations in programming skills necessary for students with a limited computer science background to develop fluency and basic skills in the concepts of software development for biomedical informatics. Specific topics covered will include Unix/Linux shell programming, Python, databases, Applications Programming Interface (APIs), software versioning, and data management.

**Prerequisite(s):** Experience with programming in a scripting, database management, or object-oriented programming language is strongly recommended but not required.

**BMI 8850 BIOMEDICINE FOR THE NONMEDICAL PROFESSIONAL (3 credits)**

This course will cover the basic principles of molecular and cellular biology, human anatomy, physiology, and pathology that are essential to an informed use of biomedical data. The biomedical topics will be interspersed and complemented with discussions about relevant data sources and datasets, emphasizing their strengths and weaknesses, and the lectures will be enriched with virtual anatomical dissections. Reading assignments from the primary literature and multimedia materials will supplement the textbook.

**Prerequisite(s):** Class standing of senior or above

**BMI 8866 BIOINFORMATICS ALGORITHMS (3 credits)**

The main objective of this course is to provide an organized forum for students to understand the foundations of algorithmic design and analysis in the context of health and biological data. The course will present fundamental concepts in algorithms (exhaustive, greedy, graph, heuristic, and more) and explore how those concepts extend to bioinformatics and related fields, such as biomedical informatics, and health informatics. Students will learn about historical context of these algorithms and how they were pivotal in forming more complex modern approaches, and will explore advanced algorithms in their area of interest. Students will also exercise their programming skills with the opportunity to implement and apply bioinformatics algorithms to real data, so to better grasp the technical components of algorithmic design and analysis. (Cross-listed with BIOI 4860).

**BMI 8896 COMPUTERIZED GENETIC SEQUENCE ANALYSIS (3 credits)**

The goal of this course is to introduce students to major topics in computerized analysis of genetic sequences. In particular the course will allow students to become familiar with the computational tools and software that aid in the modern molecular biology experiments and analysis of experimental results. Following the completion of this course, it is expected that the students will have a basic understanding of the theoretical foundations of the sequence analysis tools and develop competence in evaluating the output from these tools in a biological context. This course will emphasize hands-on experience with the programs for nucleotide and amino acid sequence analysis and molecular phylogeny. (Cross-listed with BIOI 4890).

**Prerequisite(s):** Permission from the instructor.

**BMI 8900 INDEPENDENT RESEARCH IN BIOMEDICAL INFORMATICS (1-3 credits)**

The content of the course will vary, however both the student and the faculty member must sign an Independent Research Agreement and file it with the Biomedical Informatics Graduate Program Committee before registration for the course. This agreement will detail the project, the schedule for its completion, the form of the output, the method of evaluation and other relevant information pertaining to the project.

**Prerequisite(s):** Permission of instructor, and at least 12 hours of course work toward the MS BMI program should be completed.

**BMI 8910 INTERNSHIP (1-3 credits)**

The purpose of this course is to provide the students with an opportunity for practical application and further development of knowledge and skills acquired in the Biomedical Informatics graduate program. The internship gives students professional work experience and exposure to the challenges and opportunities faced by IT professionals in the workplace.

**Prerequisite(s):** Students must have completed a minimum of 12 credit hours towards the MS in BMI program. Not open to non-degree graduate students.

**BMI 8950 BIOMEDICAL INFORMATICS GRADUATE CAPSTONE (3 credits)**

The graduate capstone course challenges students to prove their mastery of the skills and domain knowledge they have gathered throughout their program of study. The course begins with a module on project management and research best practices. The majority of the course is structured around facilitating a non-trivial semester-long project, often in service to a third-party project sponsor, such as a community, industry, or government partner. The course is intended for students that have selected the coursework option, not thesis, and that are close to graduation.

**Prerequisite(s):** Students must have 9 credit hours or fewer left in the program, including this course. Students must have completed all core courses, and core electives are recommended but not required. Not open to non-degree graduate students.

**BMI 8970 INDEPENDENT STUDY IN BIOINFORMATICS (1-3 credits)**

This is a variable-credit course designed for graduate students in bioinformatics who would benefit from independent reading assignments and research-type problems. Independent study enables coverage of topics not taught in scheduled course offerings.

**Prerequisite(s):** Permission of a supervising faculty member and approval of the Bioinformatics Program Committee Chair. A formal description of the problem area to be investigated, the resources to be used, and the results to be produced must be prepared.

**BMI 8990 THESIS IN BIOMEDICAL INFORMATICS (1-6 credits)**

A research project, designed and executed under the supervision of the chair and approval by members of the graduate student's thesis advisory committee. In this project the student will develop and perfect a number of skills including the ability to design, conduct, analyze and report the results in writing (i.e., thesis) of an original, independent scientific investigation.

**Prerequisite(s):** Graduate major in BMI and approval of the Thesis Advisory Committee. Not open to non-degree graduate students.

**BMI 9900 ADVANCED RESEARCH IN BIOMEDICAL INFORMATICS (3 credits)**

This course provides a format for exploring advanced research areas for doctoral students in Biomedical Informatics and related fields. Specific topics will vary in keeping with research interest of faculty and students.

**Prerequisite(s):** Admission to graduate program in Biomedical Informatics. Not open to non-degree graduate students.

**BMI 9980 INDEPENDENT RESEARCH IN BIOMEDICAL INFORMATICS (1-3 credits)**

This course allows students to research a topic of their interest that is not available in a formal course. The topic to be studied must be agreed upon by the student and the instructor.

**Prerequisite(s):** Admission to Ph.D. program in Biomedical Informatics and permission of instructor. Not open to non-degree graduate students.

**BMI 9990 DISSERTATION (1-12 credits)**

The dissertation is an original research project conducted and written under the direction of a faculty dissertation committee supervisory committee. The dissertation provides the student with an opportunity to do original research that contributes to advancing the body of knowledge in health or bioinformatics and demonstrate technical mastery of the discipline.

**Prerequisite(s):** Admission to the Ph.D. program in Biomedical Informatics and candidacy for the Ph.D. degree. Prior to enrolling for dissertation hours, the students must have permission of the supervisory committee. Not open to non-degree graduate students.

**BSAD 8000 BUSINESS ETHICS: ACHIEVING SOCIAL RESPONSIBILITY (2 credits)**

This core MBA course will explore the relationship between law and ethics, will examine the generally-accepted theoretical principles associated with doing business ethically, and will examine practical ethical issues associated with various facets of business.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent) or admission to the MAcc program. Students with an undergraduate major or a graduate degree in Law may not include this course in a plan of study for the MBA degree. Not open to non-degree students

**BSAD 8026 RESEARCH METHODS IN ECONOMICS AND BUSINESS (3 credits)**

Covers the methodology of economics: choosing a research topic, literature search tools, data source identification, data summary techniques, basic statistical data analysis using statistical packages, and clear economics writing. The student will become familiar with these techniques through text materials, journal studies, and completion of an empirical economics paper.

**Prerequisite(s):** Graduate standing. Not open to nondegree students.

**BSAD 8030 INFORMATION TECHNOLOGY IN BUSINESS (3 credits)**

The premise of this course is that today's managers must learn to use information technology to create competitive firms, manage global corporations and provide useful products and services to customers. Accordingly, the content of this course is focused on use of information technology for competitive advantage. Students will develop case studies of firms who have achieved this objective. Furthermore, the course will address emerging technologies and their current and potential application.

**Prerequisite(s):** Completion of MBA foundation courses and BSAD 8060 (prior to or concurrent). Not open to nondegree students.

**BSAD 8040 BUSINESS AND INFORMATION TECHNOLOGY: CONNECTING PEOPLE AND INFORMATION (2 credits)**

The premise of this course is that today's managers must learn to use information technology to create competitive firms, manage global corporations and provide useful products and services to customers. Accordingly, the content of this course is focused on use of information technology for competitive advantage. Students will develop case studies of firms who have achieved this objective. Furthermore, the course will address emerging technologies and their current and potential application.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent).

Students with an undergraduate major or a graduate degree in management information systems may not include this course in a plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8060 PEOPLE: CULTIVATING SKILLS FOR LEADERSHIP (2 credits)**

This course will prepare students with the skills to effectively enact the critical leadership skills of listening, employee feedback and coaching, goal-setting, empowerment/delegation, influencing, interviewing, conflict, negotiation, intercultural awareness, team/group discussions, and business etiquette.

**Prerequisite(s):** Admission to the MBA program. Not open to non-degree graduate students.

**BSAD 8066 HEALTHCARE ANALYTICS FOR BUSINESS (3 credits)**

This course will focus on the mixing of analytics and technology to develop key performance indicators that integrate and evaluate clinical, administrative, and financial performance. Concepts in this course explore the intersection of information management, performance metrics, data visualization, and result communication spanning across the healthcare ecosystem. Topics covering health outcome analysis, financial performance, developing analytic strategies, data quality and governance, and the four stages of actionable intelligence are all used to educate the advantages of leveraging analytics. (Cross-listed with MGMT 4060, SCMT 4060).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8070 COACHING & DEVELOPING OTHERS (2 credits)**

Organizational leaders must effectively coach and develop others in order to ensure sustainable long-term organizational performance. Both through one-on-one feedback and coaching as well as through strategy-aligned organizational-level talent development programs, leaders establish the organization's culture of employee development and growth.

**Prerequisite(s):** Admission to Executive MBA Program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8076 INTERNATIONAL LOGISTICS MANAGEMENT (3 credits)**

This course will focus on the logistics of international trade and how managers facilitate the flow of goods and services in import and export environments. Students will learn about infrastructure and business practices needed to manage international transportation, communications, services, and regulatory requirements. Students will develop an understanding of international terms of trade, transaction risk management, and location decisions for placement of warehouses and distribution centers. (Cross-listed with SCMT 4070).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8080 BUSINESS FORECASTING (3 credits)**

The course will cover forecasting tools and applications applied to business settings. The first half of the course will cover traditional Econometric forecasting methods and the second half of the course will focus on predictive analytics models and machine learning. Time in the computer lab will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with ECON 8310).

**Prerequisite(s):** ECON 8320 (or equivalent programming experience) or permission of instructor. Not open to non-degree graduate students.

**BSAD 8090 ESSENTIAL LEADERSHIP SKILLS (3 credits)**

This course will teach students the interpersonal skills necessary to effectively manage others. Second, this course will serve as a vehicle to assess the business content knowledge and computer literacy of incoming MBA students in order to provide customized remediation recommendations for each student. Third, the course will collect information that will be used for assessment and accreditation purposes to evaluate the effectiveness of the MBA program. This course will address the following MBA program themes: communication, change agent, teamwork, information technology, critical thinking and information gathering and analysis.

**Prerequisite(s):** Admission to the MBA program and completion of MBA foundation courses (or equivalent) or may be taken concurrently with the final foundation course. Not open to nondegree students.

**BSAD 8096 MANAGING COLLABORATIVE ENGAGEMENT (3 credits)**

This course will provide students with the opportunity to develop knowledge and strategies for leading teams, enhancing collaboration, building consensus, problem solving in teams, facilitating group processes, and designing collaborative workspaces. (Cross-listed with MGMT 4090, ACMP 4090, SCMT 4090)

**Prerequisite(s):** Admission to a graduate program at UNO or the STRATCOM Leader Fellow Program. Not open to non-degree students.

**BSAD 8100 MANAGERIAL ECONOMICS (3 credits)**

The course will offer students tools of analysis drawn from consumer theory and the theory of the firm in order to improve the understanding of human behavior as it is constrained in the context of business decision-making. This course is intended for students who are seeking the degree of Master of Science in Economics or the degree of Master of Business Administration.

**Prerequisite(s):** ECON 2200 and 2220 or BSAD 8180 and BSAD 8060. BSAD 8060 may be taken prior to or concurrent. Not open to nondegree students.

**BSAD 8110 ACCOUNTING AND FINANCIAL FUNDAMENTALS (3 credits)**

The course is designed to give incoming graduate students the foundation in accounting that is necessary for subsequent graduate courses. Emphasis is on introducing the students to as many accounting concepts as possible.

**Prerequisite(s):** Graduate admission or permission of the appropriate graduate advisor. This course cannot be used in a plan of study for any graduate program at UNO. Not open to non-degree graduate students.

**BSAD 8136 HUMAN RESOURCE MANAGEMENT (3 credits)**

This course is a comprehensive review of the field of human resource management and its relevance to employees, managers, and organization stakeholders for goal achievement. The design of this course is structured to educate future managers and leaders on the importance of utilizing effective HR methods that comply with federal laws and the critical role of HR professionals in achieving the organization's positive workplace culture, competitive advantage, and overall success. (Cross-listed with MGMT 4030).

**Prerequisite(s):** BSAD 8136 students do not have any prerequisite courses; however, BSAD 8250 (Organizational Behavior) is recommended prior to enrollment.



**BSAD 8140 BUSINESS INTELLIGENCE ANALYSIS (2 credits)**

In BSAD 8440 you learned how to extract and manipulate data in a business intelligence tool. In this class you will learn to use this data to extract business knowledge. To do this, you will learn about the data model, methods of aggregation, and visualizations in the business intelligence (BI) software.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8440. Not open to non-degree graduate students.

**BSAD 8146 TOTAL REWARDS (3 credits)**

This course is a comprehensive review of the theory and practice of developing and implementing cost-effective employee compensation and benefits programs. Students will gain and utilize effective strategies for managing the single largest controllable expense for organizations; employee pay and benefits. The design of this course is most beneficial for students pursuing future careers in management and human resource professions. (Cross-listed with MGMT 4010).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8150 ECONOMICS: ESSENTIAL CONCEPTS FOR MANAGERS (2 credits)**

This course exposes MBA students to fundamental economic concepts necessary for successful business planning and financial success. Topics include: Comparative advantage and international trade, market dynamics, the role that the competitive landscape plays in company decision-making, macroeconomic growth and development, and monetary and fiscal policy and their impact on business activity.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in economics may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8156 TALENT DEVELOPMENT (3 credits)**

This course is a comprehensive review of the theory and practice of developing and implementing cost-effective employee training and development programs to optimize human capital effectiveness in modern organizations. The course is designed to enable future managers and human resource professionals to utilize effective strategies for assessing employee training needs and developing appropriate solutions to maximize talent utilization. (Cross-listed with MGMT 4120).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8160 INTERMEDIATE ANALYTICS (2 credits)**

Business Intelligence software tools are statistical in nature. Many of the visualizations/widgets use statistics "under the hood" to provide insights to you the user. Can you trust these insights? How are they calculated? When are they appropriate? In this class, you will learn the answers to these questions.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8140. Not open to non-degree graduate students.

**BSAD 8166 STAFFING THE ORGANIZATION (3 credits)**

This course is a comprehensive review of issues and techniques involved in the acquisition and management of a high quality and diverse workforce for optimal organizational effectiveness. Students pursuing future manager and human resource professions will benefit from practice utilizing effective strategies for recruiting, selecting, placing, and integrating new employees into an organization's workforce. (Cross-listed with MGMT 4110).

**Prerequisite(s):** BSAD 8136 is recommended but not required.

**BSAD 8176 EMERGING TRENDS IN SUPPLY CHAIN MANAGEMENT (3 credits)**

This course will focus on megatrends influencing supply chain management and design in the 21st century. Key concepts in this course will include contemporary opportunities and challenges in creating customer value via the supply chain with a focus on globalization, sustainability, and risk management. Specific topics will include the influence of the empowered customer on supply chain design, global supply chain trends, and the need for integration of technology and talent to create a competitive advantage. (Cross-listed with SCMT 4170).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8190 APPLICATIONS IN ANALYTICS (2 credits)**

What is a 'business question' and how do you answer it with data? In this class you will learn to form testable business questions. This course will build on the knowledge you gained in BSAD 8440, BSAD 8140, and BSAD 8160 to answer your business questions with the help of business intelligence software.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8160. Not open to non-degree graduate students.

**BSAD 8200 MANAGERIAL ACCOUNTING (3 credits)**

A study of concepts, analysis and procedures of accounting utilizing internal financial and non-financial data which provides management with information for planning and controlling routine operations, for non-routine decisions, policy-making and long-range planning; and for external reporting to stockholders, governments and interested parties.

**Prerequisite(s):** ACCT 2010 and 2020 or BSAD 8110, and BSAD 8060. BSAD 8060 may be taken prior to or concurrent. Not open to nondegree students.

**BSAD 8206 CONSULTATIVE SELLING PRINCIPLES (3 credits)**

The primary focus of the Consultative Selling Principles course is to develop the behaviors, methodologies, principles, and processes required to successfully lead and manage complex selling initiatives to a win-win close. The course examines and applies, through role playing and other activities, the critical relationship building, critical thinking, problem solving, listening and negotiating capabilities which are the foundation skills underlying consultative selling. (Cross-listed with MKT 4200)

**Prerequisite(s):** MKT 3310 with 'C+' or better; MKT 3100 with C+ or better; GPA of 2.5 or better; or permission of instructor. Not open to non-degree graduate students.

**BSAD 8210 ACCOUNTING: DECISIONS & CONSEQUENCES (2 credits)**

Managers and administrators must be able to understand, analyze, and use accounting information to make operational and strategic business decisions. In this course, we will study practical uses of accounting information to address the problems and decisions managers face in business. Emphasis is placed on the user of accounting information rather than the preparer. Upon completion of this course, a student should be able to use accounting information to make management decisions, understand how accounting rules inform those decisions, and consequently, how those decisions affect a company's financial reports.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or graduate degree in accounting may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8216 SELLING FINANCIAL SERVICES (3 credits)**

Selling Financial Services concentrates on methods to effectively sell services and products in the financial services industry, including the banking, brokerage and insurance sectors. Targeting, initiating, and acquiring client relationships, expanding business opportunities, and maintaining long-term client relationships are the course's focal points. This integrative course is designed to provide students with a basic understanding of the selling profession and sales culture within the financial services industry. (Cross-listed with MKT 4210, FNBK 4210).

**Prerequisite(s):** Not open to non-degree graduate students.

**BSAD 8220 ADVANCED APPLICATIONS IN ANALYTICS (2 credits)**

Using the knowledge gained in BSAD 8440, BSAD 8140, BSAD 8160, and BSAD 8190, each student in this course will work individually to apply the entire business analytics process (starting with data collection and ending with using results to make informed decisions) to a real problem in their own organization.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8190. Not open to non-degree graduate students.

**BSAD 8226 GLOBAL STRATEGIC ACCOUNT MANAGEMENT (3 credits)**

Throughout this course, the management of strategic account programs at national, multi-country, and global levels will be addressed. The primary focus of the curriculum is on the critical success factors for driving revenue, sustainable long term-growth and profitability with a base of core strategic buyers.

**Prerequisite(s):** Senior or graduate student standing and permission of the instructor. Not open to non-degree graduate students.

**BSAD 8230 LEADING CHANGE & INNOVATION (2 credits)**

This course focuses on providing leaders with the knowledge and ability to lead organizational change and enhance organizational innovation. Topics include organizational culture, organizational design, and organizational processes (including reward systems).

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8236 GLOBAL BUSINESS MANAGEMENT (3 credits)**

The central objective of this course is to explore the unique opportunities and challenges that confront international managers as they navigate the complex and ever-changing global economic, political, legal, technological, and cultural environment. This course will particularly focus on people, values, and culture, better equipping students to both undertake an international career as well as effectively lead organizations with a culturally diverse workforce in any environment. (Cross-listed with MGMT 4150).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8240 EFFECTIVE LEADERSHIP OF PEOPLE (2 credits)**

This course aims to enhance the leadership effectiveness of students by developing knowledge of what constitutes effective leadership and how to apply leadership concepts and models.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8250 ORGANIZATIONAL BEHAVIOR: ENHANCING HUMAN & ORGANIZATIONAL CAPABILITIES (2 credits)**

This course will prepare students with the knowledge necessary to manage and lead organizations effectively. Students will learn management theories, understand important research findings in organizational behavior, and apply both theory and research results to real organizational situations, thus giving them the capacity to use OB theories to enhance organizational effectiveness.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent).

Students with an undergraduate major or a graduate degree in management may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8260 EFFECTIVE USE & REPORTING OF ACCOUNTING INFORMATION (2 credits)**

This course focuses on the use and reporting of accounting information, with an emphasis on financial statements and how executive decisions can influence these statements. Financial statements, including footnotes and explanatory material, are the primary instruments utilized by parties external to the enterprise in making judgments about the enterprise. By understanding how management decisions are reflected in the financial statements, managers will understand how they can influence their judgment.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8280 EMPLOYEE RECRUITMENT, ENGAGEMENT, AND RETENTION (2 credits)**

Effective recruitment, engagement, and retention of highly motivated and high performing employees is critical for organizational success. This course will address the key organizational characteristics that must be in place for this to occur.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership.

**BSAD 8300 ORGANIZATION THEORY & DESIGN (3 credits)**

This course is designed to increase students' understanding and knowledge of how organizations are designed and structured in order to create value and competitive advantage, and how organizations can operate in an effective and efficient manner in an ever-changing environment. The course will address topics such as: organizational effectiveness, organizational structure, organizational design, organizational culture, organizational technology, the external environment, organizational change, and the organizational life cycle. The ultimate goal is for students to be able to understand how organizations should be structured as a result of both external and internal factors.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8310 MANAGING PERFORMANCE IN ORGANIZATIONS (3 credits)**

A human behavior course emphasizing the areas of individual behavior, interpersonal behavior, group behavior and the interplay of human and non-human factors.

**Prerequisite(s):** Essential Leadership Skills (BSAD 8060) or admission to the MAcc program. Not open to nondegree students.

**BSAD 8326 SALES MANAGEMENT (3 credits)**

The student will be exposed to current research findings in sales management and to business cases and simulations where sales management theories and concepts will be applied. This course will prepare students to develop and implement specific compensation, motivation, and evaluation strategies for managing sales professionals across a wide variety of organizations. (Cross-listed with MKT 4320.)

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8330 LEADING TEAMS (2 credits)**

This course focuses on building and leading high-performing teams in organizations. Topics include how to evaluate team effectiveness, how to create and develop teams that are cohesive and high-performing, how to lead and facilitate teams, and how to diagnose and intervene when teams are experiencing problems.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8336 PROJECT MANAGEMENT (3 credits)**

This course focuses on the systemic exploration of planning and executing complex projects to create organizational success. Using a comprehensive understanding of principles, methodologies, and tools within project management, students will learn how to initiate critical processes, plan objectives and constraints, execute management and leadership, monitor budgets and development, and close outcomes of complex projects. Skills obtained from this course enhance individuals' ability to recognize, identify, and prioritize organizations' culture and structure to lead projects across various industries efficiently. (Cross-listed with MGMT 4330, SCMT 4330)

**Prerequisite(s):** Admission to Graduate College, MBA Program; or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8340 INTERNATIONAL BUSINESS STUDY ABROAD (3 credits)**

This course provides students with an international business and cultural experience through a study tour in a selected international location. Students will develop an understanding of the factors that affect international business decisions by visiting American companies operating abroad and foreign companies that export goods and services to the U.S.

**Prerequisite(s):** Instructor Permission.

**BSAD 8345 CONSUMER BEHAVIOR (3 credits)**

Consumers purchase, use, experience, and dispose of products and services as part of their consumption process. How and why consumers choose various brand options, form judgments about these brands, and decide which options to buy and/or re-buy are essential knowledge for marketing professionals. The course covers the psychological and social issues that guide consumption decisions. (Cross-listed with MKT 3320).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor.

**BSAD 8356 GLOBAL SOURCING AND INNOVATION (3 credits)**

This course focuses on global suppliers as partners in the development and commercialization of new products. Students will learn about open innovation and the integration of internal and external business systems in new product innovation. Students will develop an understanding of regulatory policies related to information sharing and the intellectual property rights of buyers and suppliers. (Cross-listed with SCMT 4350).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8360 EFFECTIVE MANAGEMENT OF CAPITAL STRUCTURE, CASH, & RISK (2 credits)**

Students will develop strategic decision making skills by using financial concepts including time value of money, capital budgeting processes, cash flow forecasting and project risk analysis. Topics covered include: capital budgeting, financial statement analysis, capital structure, financial risk analysis.

**Prerequisite(s):** Admission to the Executive MBA program or Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8366 E-MARKETING (3 credits)**

This course focuses on utilizing the Internet as a marketing platform. Course content includes discussion of how the Internet is used by businesses for designing products, pricing, promotions, distribution, positioning, gathering information, and cultivating relationships with stakeholders. The discussion about the rise of social media, sharing economy, virtual reality devices, and other relevant trends will also be part of the course. (Cross-listed with MKT 4360).

**Prerequisite(s):** BSAD 8400 with a grade of 'B' or above. Not open to non-degree graduate students.

**BSAD 8370 LEADERSHIP IN DIVERSITY, EQUITY, ACCESS, AND INCLUSION (2 credits)**

This course will focus on the role that organizational leaders play in proactively addressing organizational issues related to diversity, power, access, and equity. The course will explore tensions through the range of dimensions in which diversity is manifested among business leaders, staff, and stakeholders (which includes anyone impacted by the organization's business decisions - e.g., employees, contractors, suppliers, customers, and the community). Policies, systems, histories, structures, and legislation will also be discussed.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8376 SUPPLY CHAIN ANALYTICS (3 credits)**

This course focuses on integrating supply chain management through the use of key performance indicators. Key concepts in this course include data visualization, supplier performance metrics, service-dominant logic, and the supply chain for data. Specific topics include the influence of the empowered customer on supply chain metrics, using metrics to develop a competitive advantage, data-driven decision making, and the four stages of actionable intelligence. (Cross-listed with SCMT 4370).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8380 EFFECTIVE SYSTEMS, OPERATIONS, AND IT (2 credits)**

Students will learn how to employ decision-making skills to create a long-term competitive advantage for an organization through operational and technical excellence. Key concepts in this course will include developing a view of organizations as technical and behavioral systems, operations management, quality management, strategies related to IT procurement, deployment, maintenance and security, and the supply chain. Specific topics will include applied systems theory, process improvement, quality assurance, supply chain management, IT systems development strategies, and issues related to systems security, data security, and data privacy.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business

**BSAD 8386 INDUSTRIAL PURCHASING AND LOGISTICS MANAGEMENT (3 credits)**

This course will focus on the strategic procurement of products and services in order to gain a competitive advantage through integrated supply management. Students will learn about strategic supply management, contract negotiation, and supplier quality management. Students will develop an understanding of supplier performance management through the use of supply chain information systems. (Cross-listed with MKT 4380, SCMT 4380)

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8396 MARKETING ANALYTICS (3 credits)**

This course focuses on the application of data analytics in marketing decision making (e.g., segmentation, sales forecasting, and resource allocation). Students will learn to apply statistics and econometrics to solve marketing problems. Key topics in this course include marketing data visualization, marketing metrics, descriptive and predictive analytics, and digital marketing analytics. This course takes a very hands-on approach with real-world databases and equips students with tools that can be used immediately on the job. (Cross-listed with MKT 4370).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8400 MARKETING POLICIES (3 credits)**

This course provides an introduction to the fundamental concepts of marketing, including a customer orientation, matched with attention to competition and core strengths. The course will illustrate strategies and principles that will help you understand how marketing managers, product managers or service managers must think through their situations, determine their goals and lay a course to achieve those goals.

**Prerequisite(s):** Completion of MBA foundation courses and BSAD 8060 (prior to or concurrent); or admission to MAcc program. Not open to nondegree students.

**BSAD 8416 DIVERSITY, EQUITY, ACCESS AND INCLUSION SOLUTIONS FOR MINIMIZING RISK (3 credits)**

This course provides students an opportunity to explore the various aspects of power, access, and equity as it relates to the business environment. Students will explore tensions through the range of dimensions in which diversity is manifested among business leaders, staff, and stakeholders (include anyone impacted by business decisions, such as: employees, contractors, suppliers, customers, and the community) through policies, systems, histories, structures, and legislation. Students will have the opportunity to learn differences that individuals bring to a business environment and how stakeholders can capitalize on those differences by creating long-term inclusive environments. (Cross-listed with LAWS 4410).

**Prerequisite(s):** Admission to the MBA program. Not open to non-degree graduate students.

**BSAD 8420 MARKETING: UNDERSTANDING CONSUMERS AND MARKETS (2 credits)**

This course exposes MBA students to the fundamental concepts, practices and issues of marketing. A wide range of marketing practices and structures will be explored including product and service firms, consumer and business markets, profit and not-for-profit organizations, domestic and global companies, and small and large businesses.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent). Students with an undergraduate major or a graduate degree in marketing may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8426 BUSINESS DEMOGRAPHICS (3 credits)**

The goal of this course is to develop a demographic perspective in order to assist in understanding the business environment and business policy. How population change impacts consumer markets and all of the functions (for example, accounting, finance and management) that must exist for these markets to perform. Includes a history of population change and policy as well as a view toward international population considerations. (Cross-listed with MKT 4420).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8430 STRATEGIC BRAND MANAGEMENT (3 credits)**

An exploration of the characteristics, meanings, and management of brands in the business world. The course examines brands as a strategic asset, and draws on managerial, consumer, and cultural perspectives.

**Prerequisite(s):** BSAD 8420 or permission of instructor. Not open to nondegree students.

**BSAD 8435 MARKETING INNOVATION (3 credits)**

Product, service, and process innovation are essential drivers of firm performance. However, firms face considerable and complex challenges when bringing innovative ideas to life. For example, what marketing research methods should we employ to uncover vital consumer insights? How do these insights influence the development and launch of new products and services? What differentiated value are we delivering to our consumers? How do we successfully bring this new product or service to market? How does a brand's purpose and personality influence consumers' perceptions, purchase decisions, adoption, and engagement? This course will cover key marketing principles involved in the development and launch of new and innovative products and services - from conception to commercialization. Furthermore, we will explore how new-age technologies impact each stage of the development and launch processes. (Cross-listed with MKT 3400).

**Prerequisite(s):** BSAD 8420 or equivalent; and admission to Graduate College, MBA Program or by permission of the instructor.

**BSAD 8440 BUSINESS INTELLIGENCE DATA EXPLORATION (2 credits)**

The first in any analytics project is to get data ready for analysis. In this class you will learn to extract data from a business data source and ready it for analysis in a business intelligence software tool. In the process you will learn tools necessary for this process including SQL, Power Query, M, and DAX.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics. Not open to non-degree graduate students.

**BSAD 8450 SEMINAR IN MARKETING (3 credits)**

Exploration, study and critical analysis of contemporary marketing problems, trends, methods and approaches for seminar discussion and written report.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8456 MANAGERIAL NEGOTIATION STRATEGIES (3 credits)**

This course introduces students to the theory and practice of negotiation across various organizational settings. The ability to successfully negotiate an outcome is an important aspect of management and leadership. Negotiation can be used to determine multiparty relationships, manage conflict resolution, and improve organizational outcomes. Using a combination of conceptual frameworks, roleplaying exercises, and debriefing opportunities, the design of this course is structured to help students understand the power and influence negotiation has over the successful outcomes of managers, leaders, and organizations. (Cross-listed with MGMT 4450, SCMT 4450).

**Prerequisite(s):** Admission to Graduate College, MBA Program, or by permission of the instructor.

**BSAD 8476 BEHAVIORAL FINANCE & INVESTING (3 credits)**

This course focuses on how actual investor behaviors and market behaviors differ from traditional theories of finance. This course will examine psychological biases, identify how such biases influence financial markets and settings, and explore methods that can be utilized to recognize and overcome such behavioral pitfalls. (Cross-listed with FNBK 4470).

**Prerequisite(s):** Admission to graduate college, MBA program, or by permission of instructor. Not open to non-degree graduate students.

**BSAD 8480 GLOBAL ECONOMICS AND CORPORATE SOCIAL RESPONSIBILITY (2 credits)**

In this course students will learn both how to apply global economic issues business strategy and how to balance socially responsible activities with the profit motive. With respect to global economics, topics include gains from trade, international trade patterns, foreign exchange markets, and barriers to trade. With respect to corporate social responsibility, topics include social responsibility and working conditions, socially responsible stewardship of the environment, and socially responsible strategies concerning human rights issues.

**Prerequisite(s):** Admittance to the Executive MBA Program or the Executive Certificate in Business.



**BSAD 8510 SECURITY ANALYSIS (3 credits)**

Study of the efficient market, fundamental and technical analysis approaches for the valuation of marketable securities. Methods of analysis are considered for the economy, industry groups and individual corporations.

**BSAD 8520 SEMINAR INVESTMENT MANAGEMENT (3 credits)**

This course focuses upon the modern portfolio theory of investment management and its application in formulation of policies for individuals and institutional investors. Topics addressed will include qualitative and quantitative analysis of the risks and returns of portfolio management using efficient market, fundamental analysis, and technical analysis approaches.

**Prerequisite(s):** BSAD 8510. Not open to nondegree students.

**BSAD 8530 BANK & FINANCIAL MARKETS (3 credits)**

This course focuses on the theory and practice in managing commercial banks. Topics covered include but not limited to: bank regulations, bank performance analysis, asset liability management, credit analysis and consumer loans. The course emphasizes the link between theory and practice through assigned course related readings, guest lecturers from industry experts, and a comprehensive bank research project on a local bank of your choice. At the end of the course, students should have a good understanding of basic banking theories as well as banking practices, and current issues and challenges facing the banking industry.

**Prerequisite(s):** BSAD 8500. Not open to non-degree graduate students.

**BSAD 8540 MULTINATIONAL FINANCIAL MANAGEMENT (3 credits)**

The focus of this course is on multinational financial management as viewed and practiced by the multinational firm and on current developments in international financial markets, including global banking. Familiarity with certain areas of the firm's environment, such as the international monetary system, the European Monetary System, and determination of exchange rates under alternative regimes, is essential to the international financial manager.

**BSAD 8550 SEMINAR IN FINANCE (3 credits)**

This course will address specific financial management topics which will vary by semester and is intended for graduate students.

**BSAD 8560 MARKETING STRATEGY: CUSTOMERS AND MARKETS (2 credits)**

This course will focus on how successful businesses match their objectives and resources with opportunities in the marketplace by identifying and measuring consumer needs, determining target markets and deciding which products and services to offer. This course will also address pricing, promotion, and distribution strategies to create competitive advantage in domestic and international markets.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8570 EFFECTIVE STRATEGIC MANAGEMENT (2 credits)**

This course centers around the theme that a company achieves sustained success if and only if its managers (1) develop, and revise as needed, an action-oriented strategic plan and (2) implement and execute the plan with some proficiency. Students will develop the strategic thinking skills needed to formulate and execute successful strategies for firms/organizations in a variety of industries and dynamic environments. Emphasis is given to the contributions of several business disciplines of study, such as marketing, finance and management, to understanding both the internal operations of the organization and the influences of the external environment. This course is integrative and introduces both the theory and practice that enables that integrative process.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business. Not open to non-degree graduate students.

**BSAD 8576 INVESTMENT MANAGEMENT FOR FINANCIAL ANALYSTS (3 credits)**

This course provides critical knowledge needed for students pursuing a career in investment management. The topic areas bridge academic theory, current industry practice, and ethical and professional standards and comprehensively address the areas assessed in the Chartered Financial Analyst examinations. (Cross-listed with FNBK 4570)

**Prerequisite(s):** Graduate standing. Not open to non-degree graduate students.

**BSAD 8590 EXECUTIVE MBA CAPSTONE PROJECT (4 credits)**

Students in the Executive MBA capstone project course will complete an applied consulting project for an organization that requires them to integrate knowledge across multiple Executive MBA program knowledge areas. Students will identify the key problem(s) to be solved, use sound methodologies to gather necessary data, identify and employ relevant evidence-based research and practitioner literatures, apply relevant models and theories to guide the generation of potential solutions and implementation strategies, and identify the feasibility and financial implications of their proposed solution(s).

**Prerequisite(s):** Admission to the Executive MBA Program. Not open to non-degree graduate students.

**BSAD 8596 RISK MANAGEMENT FOR BUSINESS MANAGERS (3 credits)**

An analysis of risk management techniques for handling the risk exposures most businesses face, including insurance, self insurance, risk control, and risk avoidance, among others. (Cross-listed with FNBK 4590.)

**BSAD 8600 REAL ESTATE FINANCE THEORY AND APPLICATIONS (3 credits)**

This course explores advanced financial analysis tools and methodologies used to quantify complex factors surrounding real estate productivity, value, investment, and project feasibility. Specific course topics will coincide with student interest in one of three focus areas: Investment, Development, or Commercial Finance.

**Prerequisite(s):** RELU 3410 and BSAD 8630, or permission of Real Estate Program Director.

**BSAD 8605 REAL ESTATE PRINCIPLES AND PRACTICES (3 credits)**

This is a survey course in real estate principles and practices, which is designed to familiarize students with industry terminology, current practices, and cover the following topics: Licensure, property rights, legal descriptions, real estate law and contracts, appraisal, financing, investments, Fair Housing, and related topic areas. This course provides foundational knowledge of the real estate field and will prepare students to successfully complete more advanced real estate coursework. NOTE: Students cannot receive credit for both RELU 2410 and RELU 3410. (Cross-listed with RELU 3410).

**Prerequisite(s):** Admission to Graduate College, MBA Program, or permission of Real Estate Program Director.

**BSAD 8606 FINANCIAL RISK MANAGEMENT (3 credits)**

The course provides students with an intermediate level analysis of financial derivatives, and the use of these instruments for managing risk in financial institutions. (Cross-listed with FNBK 4600.)

**Prerequisite(s):** BSAD 8500 and 8510 or their equivalent, and graduate standing. Not open to nondegree students.

**BSAD 8610 REAL ESTATE APPRAISAL (3 credits)**

This course addresses the fundamentals of real estate valuation and appraising, including factors affecting value, valuing land, improvements, and special classes of residential property, appraisal practice and rules, depreciation and obsolescence, and the mathematics of appraising.

**Prerequisite(s):** RELU 3410 and BSAD 8630, or permission of instructor.

**BSAD 8616 REAL ESTATE INVESTMENTS (3 credits)**

This course focuses on methods used to analyze existing and proposed commercial and residential real estate investments through dynamic programming models, and explores strategies to finance commercial real estate. The class ultimately prepares students to understand the risks and rewards associated with financing and investing in real estate. (Cross-listed with RELU 4390).

**Prerequisite(s):** RELU 2410 or RELU 3410 or FNBK 3250 or BSAD 8605 or BSAD 8630

**BSAD 8625 PROPERTY MANAGEMENT (3 credits)**

This course focuses on commercial and residential property management concepts and their application to the operation, control, and oversight of real property. The course will study leasing, tenant selection and relations, maintenance, marketing, contract management, asset management principles, as well as Fair Housing Laws and the Americans With Disabilities Act as they pertain to property management. (Cross-listed with RELU 3450).

**Prerequisite(s):** BSAD 8605, or permission of the Real Estate Program Director.

**BSAD 8626 REAL ESTATE DEVELOPMENT (3 credits)**

This course focuses on the procedures and complexities in developing and redeveloping various commercial property types and mixed-use real estate. Topics include an overview of the real estate development process, assembling a team, identifying project stakeholders, financial analysis, site selection, market analysis, and the regulatory environment. (Cross-listed with RELU 4440).

**Prerequisite(s):** BSAD 8605 or BSAD 8630, or permission of the Real Estate Program Director.

**BSAD 8630 FINANCE: UNDERSTANDING CAPITAL AND CASH (2 credits)**

As a comprehensive introduction to financial management, the course will cover various fields of finance and discuss topics including the time value of money, bond and stock valuation, capital budgeting.

**Prerequisite(s):** BSAD 8060 or BSAD 8070, 8150 and 8210. Students with an undergraduate major or a graduate degree in finance or accounting may not include this course on their plan of study for the MBA degree. Not open to non-degree graduate students.

**BSAD 8640 IT: STRATEGIC DEVELOPMENT AND DEPLOYMENT (1 credit)**

Students will gain a strategic perspective of information technology management, including current trends and best practices, and understand how technology can be used in competitive positioning. Processes for innovation and research and development spending and new business models will be covered.

**BSAD 8650 VISION & STRATEGIC LEADERSHIP (2 credits)**

This course focuses on the critical role that organizational leaders play in ensuring that the organization has a clear vision and a clear mission which are in alignment with the organization's business strategy and unit goals and effectiveness metrics. This course focuses on the mission and vision creation and communication process as well as vertical and horizontal goal alignment.

**Prerequisite(s):** Admission to the Executive MBA program or the Executive Certificate in Business Leadership. Not open to non-degree graduate students.

**BSAD 8660 FRONTIERS OF ANALYTICS (2 credits)**

In this program, you have learned many analytics techniques. However, analytics is a constantly evolving field with increasingly advanced methods. What techniques might be presented to you as a manager? How do you interpret these results? In this class we will explore cutting-edge analytics methods and when they are appropriate for your business.

**Prerequisite(s):** Admission to the Executive MBA Program or the Executive Certificate in Business Analytics; Completion of BSAD 8160. Not open to non-degree graduate students.

**BSAD 8680 SUPPLY CHAIN INTEGRATION (3 credits)**

This course will focus on the integration of internal and external systems designed to maximize the efficiency and effectiveness of supply chain networks developed by industrial organizations, government agencies, and not-for-profit organizations. Key concepts will include supply chain design, trends in technology, and cross-functional collaboration, coordination, and communication along the value chain. Specific topics will include the influence of empowered customers on supply chain integration, global supply chain trends, closed-loop supply chains, and the challenges and benefits of integrating technology and talent in the workplace.

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8696 EMERGING TECHNOLOGY AND INNOVATION (3 credits)**

This course equips entrepreneurially-minded students with a more complete range and vision of the viability of various startup opportunities (with a specific focus on innovative technologies and innovative business models). Students will become familiarized with the new and emerging technologies and innovations that define modern industries and product categories, as well as the various shifts in the way cutting-edge business gets done, regardless of industry. (Cross-listed with ENTR 4690, MGMT 4690).

**Prerequisite(s):** Admission to a UNO graduate degree program or permission of instructor

**BSAD 8700 BUSINESS ANALYTICS: MAKING SENSE OF DATA (2 credits)**

The purpose of this course is to provide business managers with an understanding of the important role data analytics has assumed in today's organizations. Data analytics has become a key component in accomplishing strategic and operational goals. This course is designed to familiarize students with the concepts and principles of analytics. It is targeted for graduate or MBA students who have little or no background in analytics. Therefore, it focuses on breadth of coverage rather than depth in any specific area.

**Prerequisite(s):** BSAD 8060 or BSAD 8070 (prior to or concurrent); or admission to the MAcc program. Not open to non-degree graduate students.

**BSAD 8710 SUPPLY CHAIN MANAGEMENT (3 credits)**

This course will focus on supply chain management as a key functional area of organizational success. Students will learn about current techniques used by supply chain practitioners to make strategic and tactical decisions that support the overall strategy and day-to-day operations of an organization. Students will develop an understanding of how supply chain decisions and appropriate metrics of performance can be utilized to improve the operational efficiency and effectiveness of an organization.

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8720 STRATEGIC FINANCIAL MANAGEMENT (2 credits)**

This course is intended to be advanced financial management. It will stress the theory and application of topics including, but not limited to capital budgeting, cash flow estimation, real options, capital structure, dividends and share repurchases, working capital management, budgeting, planning and forecasting, and lease management. The material covered in Strategic Financial Management will increase the student's knowledge of how to strategically manage financial resources to increase the intrinsic value of the organization.

**Prerequisite(s):** For MBA students, BSAD 8630. For MAcc students, completion of all Master of Accounting (MAcc) foundation courses. Not open to non-degree graduate students.

**BSAD 8726 INNOVATION VENTURES (3 credits)**

This team-based course provides students with the opportunity to practice the basic tools of business discovery and validation. Concepts and techniques in innovation, entrepreneurship, and strategy will be used to aid students in the venture creation process. Important considerations impacting the viability of the venture post formation will also be explored. Practical real-world experimentation is the central component of the course and will help students to conceive, develop, and launch their own innovative ventures. (Cross-listed with ENTR 4720, ACMP 4720, ACMP 8256, MGMT 4720, MKT 4720).

**Prerequisite(s):** Admission to a graduate program or by instructor permission

**BSAD 8736 ECONOMICS OF ENTREPRENEURSHIP (3 credits)**

This course will review economic theories of entrepreneurship with special emphasis on Schumpeter's theory of creative destruction. The main focus of the seminar will be on the "high-level" entrepreneurship that sometimes results in major innovations. This course will address the societal benefits of entrepreneurship, factors influencing entrepreneurial success, the policies that best encourage entrepreneurship, and how firms can survive and prosper in an entrepreneurial environment. (Cross-listed with ECON 4730, ECON 8436)

**Prerequisite(s):** ECON 2200 or permission of the instructor for all students

**BSAD 8766 SELLING IN AN ENTREPRENEURIAL CONTEXT (3 credits)**

Successful entrepreneurs are able to identify unmet needs in the marketplace and then design and sell products or services that fulfill those needs. Sales effectiveness is essential for entrepreneurs because they must be able to build sustainable sales pipelines that ensure profitable growth while simultaneously addressing other pressing issues including financing, staffing, and product development. This course will focus on consultative solution-based sales fundamentals that can be applied in an entrepreneurial selling environment. (Cross-listed with ENTR 4760, MKT 4760)

**Prerequisite(s):** GPA 2.5 or better; MKT 3100 with a "C+" or better; MKT 3310 with a "C+" or better; or permission of instructor. Not open to non-degree graduate students.

**BSAD 8776 INTRODUCTORY MAVERICK VENTURE FUND (1 credit)**

This course teaches the basics of venture capital, including, the topics of term sheets, due diligence and learning the perspectives of the entrepreneur and investor. Students in this course have the opportunity to observe more advanced students making investments, ranging from 5,000 dollars to 10,000 dollars plus. This course is the first of three, one-credit courses where students gain more advanced venture funding knowledge and application at each level. (Cross-listed with ENTR 4770).

**Prerequisite(s):** This course requires instructor approval. Students must apply and interview to take this course. Preference is given to students in their junior year, and must have three semesters of school left before graduating.

**BSAD 8786 INTERMEDIATE MAVERICK VENTURE FUND (1 credit)**

In this course, students source deals, listen to pitches, and select start-ups to be funded. Investments typically range from 5,000 dollars to 10,000 dollars plus. This course is the second in a set of three courses that increase in difficulty with each course. (Cross-listed with ENTR 4780).

**Prerequisite(s):** This course requires instructor approval. Students must have completed BSAD 8776 with a grade of C or better.

**BSAD 8796 ADVANCED MAVERICK VENTURE FUND (1 credit)**

This course applies advanced concepts of venture capital. Students will learn how to monitor and assist start-ups in the scaling process. Students learn how to leverage community partners to amplify investment opportunities. This course is the third in a set of three courses that increase in difficulty with each course. (Cross-listed with ENTR 4790).

**Prerequisite(s):** This course requires instructor approval. Students must have completed BSAD 8786 with a grade of C or better.

**BSAD 8800 MBA PROJECT-FOCUSED CAPSTONE (2 credits)**

In this Master's of Business Administration (MBA) required project-focused capstone course, students complete a service-learning consulting project for a non-profit or other type of organization. This consulting project will focus on the application of the knowledge and skills learned in the MBA program.

**Prerequisite(s):** Students must successfully complete BSAD 8630, BSAD 8420, and BSAD 8830 prior to Capstone and must also complete this course in the final semester or within the last nine (9) hours of their MBA program. Not open to non-degree graduate students.

**BSAD 8820 CONTEMPORARY BUSINESS ISSUES (1 credit)**

This course exposes students to contemporary business issues that they are likely to experience as leaders. Students will examine and synthesize academic literature relevant to an instructor-approved specific topic associated with the contemporary business issue of focus. This course can be used for MBA students who need a one credit hour course to meet their credit hour graduation requirements.

**Prerequisite(s):** BSAD 8150 or permission of instructor. Not open to non-degree graduate students.

**BSAD 8830 STRATEGY: DEVELOPING SUSTAINABLE COMPETITIVE ADVANTAGE (2 credits)**

This course centers on the theme that a company achieves sustained success if and only if its managers (1) develop, and revise as needed, an action-oriented strategic plan and (2) implement and execute the plan with some proficiency. The primary objective of this course is to sharpen the ability of students to think strategically, to diagnose situations from a strategic perspective and to develop creative solutions to enable firms to achieve a sustainable competitive advantage.

**Prerequisite(s):** Students must successfully complete BSAD 8150 and BSAD 8210 before enrolling in this course. This course must be taken within the first 20 hours of the MBA program. Not open to non-degree graduate students.

**BSAD 8880 ARTS AND THE EXECUTIVE (3 credits)**

The course will provide the graduate student with an understanding of the organizational and managerial issues involved in an arts organization as the role of the arts in the business community.

**Prerequisite(s):** Graduate. Not open to nondegree students.

**BSAD 8900 INDEPENDENT STUDY (1-6 credits)**

In this independent study course, individual students are able to complete independent research in a business-related topic area under the supervision of a faculty member. Written independent study reports are expected to include appropriate academic citations and references.

**Prerequisite(s):** Graduate and permission of MBA Advisor. Requires submission of completed Independent Study Contract to MBA Advisor prior to registration. Not open to non-degree graduate students.

**BSAD 8926 SPECIAL TOPICS IN BUSINESS (3 credits)**

This business-focused special topics course is designed to provide students the opportunity to focus on a current or emerging topic in any area of business. An in depth exploration of the topic will be undertaken with the expectation that students will play an active role in the course and engage deeply with the material and concepts addressed within the focal topic area. (Cross-listed with BSAD 4920).

**Prerequisite(s):** Not open to non-degree graduate students.

**BSAD 8990 THESIS (1-6 credits)**

A research project, under the supervision of a faculty thesis adviser in the College of Business Administration, in which the student establishes his capacity to design, conduct and complete an independent, scholarly investigation of a high originality. The research topic and the completed project must be approved by the student's faculty thesis adviser and two other faculty members, one of whom must be from outside the program area.

**Prerequisite(s):** Permission of graduate adviser. Not open to non-degree graduate students.

**CSCI 8000 ADVANCED CONCEPTS IN PROGRAMMING LANGUAGES (3 credits)**

Logic/Declarative programming is an important programming paradigm in which problems are described in terms of the properties they possess. As a result, in this style of programming many algorithmic elements, which explicitly must be articulated when writing programs in other programming languages, can be omitted. Core elements of logic programming play important roles in AI.

**Prerequisite(s):** CSCI 3320; CSCI 3660; CSCI 4220. Not open to non-degree graduate students.

**CSCI 8010 FOUNDATIONS OF COMPUTER SCIENCE (3 credits)**

This is a foundational course for students enrolled in the graduate program in computer science. The objectives are to introduce students to a large body of concepts so that they are better prepared for undertaking the core courses in the graduate program. It is assumed that student would have programmed in a high-level language and have exposure to basic college level mathematical concepts such as logarithms, exponents, sequences, and counting principles.

**Prerequisite(s):** Students are expected to have written programs using a high-level programming language and should understand basic mathematical concepts including exponents, logarithms, sequences, and counting principles. Not open to non-degree graduate students.

**CSCI 8016 INTRODUCTION TO THE THEORY OF RECURSIVE FUNCTIONS (3 credits)**

This is a proof-oriented course presenting the foundations of Recursion Theory. We present the definition and properties of the class of primitive recursive functions, study the formal models of computation, and investigate partially computable functions, universal programs. We prove Rice's Theorem, the Recursion Theorem, develop the arithmetic hierarchy, demonstrate Post's theorem. Introduction to the formal theories of computability and complexity is also given. (Cross-listed with MATH 4010, MATH 8016, CSCI 4010).

**Prerequisite(s):** MATH 2230 or MATH 2030 with a C- or better or CSCI 3660 with a C- or better or instructor's permission.

**CSCI 8040 LARGE SCALE NETWORK ANALYSIS ALGORITHMS (3 credits)**

The course will provide a review of the properties of large complex network systems, such as those occurring in social networks, epidemiology and biological systems. We will discuss algorithms to analyze these properties, their implementations, their stability under information fluctuation and how information spreads through networks.

**Prerequisite(s):** Students should be comfortable w/ programming, have knowledge of data structures, preliminary graph algorithms, & linear algebra. Suggest Prep Courses: CSCI 4150 or CSCI 8156; CSCI 3320; MATH 4050 or Permission. Not open to non-degree graduate students.

**CSCI 8050 ALGORITHMIC GRAPH THEORY (3 credits)**

The overall of the goal is to introduce advanced concepts in graph theory, graph modeling, and graph algorithms and how they can be used to solve a wide range of problems in various application domains. The course introduces students to several applied path algorithms, clustering and partitioning techniques, network flow algorithms, and weighted matching algorithms. Other advanced concepts associated with complex networks include node centralities in graphs and community detection approaches. The course will also introduce students to key classes of graphs with a particular focus on the main classes of Perfect Graphs and their applications in scheduling, chip design, mobile computing, and Biomedical Informatics. (Cross-listed with MATH 8050).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and MATH 4150 or MATH 8156 or permission of instructor. Not open to non-degree graduate students.

**CSCI 8060 ALGORITHMIC COMBINATORICS (3 credits)**

This course includes classical combinatorial analysis graph theory, trees, network flow, matching theory, external problems, and block designs. (Cross-listed with MATH 8060).

**Prerequisite(s):** MATH 3100, CSCI 3100, MATH 8105 or CSCI 8105 or instructor's permission.

**CSCI 8080 DESIGN AND ANALYSIS OF ALGORITHMS (3 credits)**

The course provides students an understanding of advanced topics in algorithms. Main topics include: growth of functions, asymptotic notation, recurrences, divide and conquer, dynamic programming, greedy algorithms, graph algorithms, and the theory of NP-Completeness. (Cross-listed with MATH 8080).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 or equivalent. Not open to non-degree graduate students.

**CSCI 8105 APPLIED COMBINATORICS (3 credits)**

Basic counting methods, generating functions, recurrence relations, principle of inclusion-exclusion. Polya's formula. Elements of graph theory, trees and searching network algorithms. (Cross-listed with MATH 8105, MATH 3100, CSCI 3100).

**CSCI 8110 ADVANCED TOPICS IN ARTIFICIAL INTELLIGENCE (3 credits)**

An in-depth study of one or more topics selected from: search techniques, knowledge representation, knowledge programming, parallel processing in Artificial Intelligence, natural language processing, image processing, current and future directions, etc. May be repeated with different topics, with permission of adviser.

**Prerequisite(s):** CSCI 4450 or CSCI 8456 or equivalent.

**CSCI 8150 ADVANCED COMPUTER ARCHITECTURE (3 credits)**

This course will provide an in-depth understanding of the key architectural concepts governing the design of state-of-the-art high-performance computers. It will introduce methods that are commonly used to trade-off the various architectural choices to design systems with the desired cost-performance requirements. The course will provide a systems level perspective to design. The emphasis will be on the cache, memory and I/O subsystems, system interconnects leading to distributed shared-memory multiprocessor systems. Multiprocessor clusters based on message passing and high-performance processor architecture will be covered. The course will also provide a brief overview of emerging system architectures including quantum computing and those used to facilitate machine learning applications.

**Prerequisite(s):** CSCI 4350, CSCI 4500 or equivalent with permission of the instructor. Not open to non-degree graduate students.

**CSCI 8156 GRAPH THEORY & APPLICATIONS (3 credits)**

Introduction to graph theory. Representations of graphs and graph isomorphism. Trees as a special case of graphs. Connectivity, covering, matching and coloring in graphs. Directed graphs and planar graphs. Applications of graph theory in several fields such as networks, social sciences, VLSI, chemistry and parallel processing. (Cross-listed with CSCI 4150, MATH 4150, MATH 8156).

**Prerequisite(s):** MATH 2030 or permission of instructor.

**CSCI 8160 INTRODUCTION TO VLSI DESIGN (3 credits)**

Introduction to the principal concepts of integrated circuits layout. Presentation of the hardware foundations, algorithmic mathematical and graph theoretical foundations of circuit layout. Topics discussed in digital design and computer architecture classes are studied at the actual layout design level such as datapath subsystems and array subsystems. Design methodology tools and testing. Hardware descriptions languages.

**Prerequisite(s):** CSCI 3320 (or CSCI 8325), CSCI 3710 and CSCI 4350 (or CSCI 8356). Not open to non-degree graduate students.

**CSCI 8206 NUMERICAL ANALYSIS (3 credits)**

This course involves solving nonlinear algebraic equations and systems of equations, interpolation and polynomial approximation, numerical differentiation and integration, numerical solutions to ordinary differential equations, analysis of algorithms and errors, and computational efficiency. (Cross-listed with CSCI 4200, MATH 4200, MATH 8206).

**Prerequisite(s):** MATH 1970 and MATH 2050 and MATH 2350 with a C- or better or permission of instructor.



**CSCI 8210 ADVANCED COMMUNICATIONS NETWORKS (3 credits)**

Advanced study of communication networks, analysis of communication needs, special problems encountered in different types of networks, efficiency and traffic analysis and emerging hardware software technologies. Detailed "hands-on" study of the TCP/IP networking protocols.

**Prerequisite(s):** CSCI 3550 or 8555 or equivalent. Not open to non-degree graduate students.

**CSCI 8256 HUMAN COMPUTER INTERACTION (3 credits)**

Human computer interaction is concerned with the joint performance of tasks by humans and machines; human capabilities to use machines (including learnability of interfaces); algorithms and programming of the interface; engineering concerns that arise in designing and building interfaces; the process of specification, design, and implementation of interfaces; and design trade-offs. (Cross-listed with CSCI 4250).

**CSCI 8266 USER EXPERIENCE DESIGN (3 credits)**

User experience (UX) design is concerned with the application of user-centered design principles to the creation of computer interfaces ranging from traditional desktop and web-based applications, mobile and embedded interfaces, and ubiquitous computing. This course provides in-depth, hands-on experience with real world application of the iterative user-centered process including contextual inquiry, task analysis, design ideation, rapid prototyping, interface evaluation, and reporting usability findings. (Cross-listed with CSCI 4260, ACMP 4260, ACMP 8266).

**CSCI 8300 IMAGE PROCESSING AND COMPUTER VISION (3 credits)**

This course introduces the computer system structures and programming methodologies for digital image processing and computer vision. The course will cover the mathematical models of digital image formation, image representation, image enhancement and image understanding. Techniques for edge detection, region growing, segmentation, two-dimensional and three-dimensional description of object shapes will be discussed. The course will concentrate on the study of knowledge-based approaches for computer interpretation and classification of natural and man-made scenes and objects.

**Prerequisite(s):** CSCI 1620 and CSCI 3320. Not open to non-degree graduate students.

**CSCI 8306 DETERMINISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of deterministic operations research models and algorithms. Topics include linear programming, network programming, and integer programming. (Cross-listed with CSCI 4300, MATH 4300, MATH 8306).

**Prerequisite(s):** MATH 2050 with a C- or better or permission of instructor.

**CSCI 8316 PROBABILISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of probabilistic operations, research models and algorithms. Topics include Markov chains, queueing theory, inventory models, forecasting, and simulation. (Cross-listed with CSCI 4310, MATH 4310, MATH 8316).

**Prerequisite(s):** MATH 2050 and either MATH 4740 or MATH 8746 or STAT 3800 or STAT 8805 all with a C- or better or permission of instructor.

**CSCI 8325 DATA STRUCTURES (3 credits)**

This is a core that will cover a number of data structures such as tree, hashing, priority queues and graphs as well as different algorithm design methods by examining common problem-solving techniques. (Cross-listed with CSCI 3320)

**CSCI 8326 COMPUTATIONAL OPERATIONS RESEARCH (3 credits)**

Survey of computational methods used in the solution of operations research problems. Some topics may include scripting to guide optimization software, constraint programming, heuristics and metaheuristics for optimization, basic machine learning algorithms, and simulation. (Cross-listed with MATH 4320, MATH 8326, CSCI 4320).

**Prerequisite(s):** MATH 3200 or CSCI 1620, and MATH 4300 each with a grade of C- or better or permission of instructor.

**CSCI 8340 DATABASE MANAGEMENT SYSTEMS II (3 credits)**

This course is an in-depth coverage of database management systems. Students will learn important principles of query processing and query optimization, transaction processing, and various database systems architectures. After taking this course, students should also be able to identify useful resources to explore future developments in the area of database management systems.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8350 DATA WAREHOUSING AND DATA MINING (3 credits)**

This course is an in-depth coverage of data warehousing and data mining. This course starts with coverage of data warehousing (an enabling technology for data mining) and covers the entire data mining process and various data mining functionalities in detail. Students will get a chance to practice knowledge learned in the course to complete term projects related to data warehousing and/or data mining. After taking this course, students should also be able to identify useful resources to explore future developments in the area of data warehousing and data mining.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8360 MACHINE LEARNING FOR TEXT (3 credits)**

This course focuses on the fundamental techniques for extraction of various insights from text data which is ubiquitous on the Web, social media sites, emails, news articles, digital libraries, and other sources. The course topics will include concepts and techniques used by search engines to crawl, index, and rank web pages on the Web, machine learning techniques for categorization of news articles into different categories, sentiment and opinion analysis of social media chats, text summarization, and information extraction.

**Prerequisite(s):** Not open to non-degree graduate students.

**CSCI 8366 PRINCIPLES OF SECURE SYSTEM DESIGN (3 credits)**

Contemporary issues in computer security, including sources for computer security threats and appropriate reactions; basic encryption and decryption; secure encryption systems; program security, trusted operating systems; database security, network and distributed systems security, administering security; legal and ethical issues. (Cross-listed with CYBR 4360, CYBR 8366)

**CSCI 8390 ADVANCED TOPICS IN DATA BASE MANAGEMENT (3 credits)**

This course is an in-depth coverage of well-selected topic(s) in recent development of database management systems. Since new developments in DBMS are very diverse, when each time when this course is offered, it will focus on one or more specific topics, and the course can be taken multiple times for credit.

**Prerequisite(s):** CSCI 4850 or CSCI 8856. Not open to non-degree graduate students.

**CSCI 8400 ADVANCED COMPUTER GRAPHICS (3 credits)**

Computer graphics continues to play an important role in computer science. This course covers the mathematical foundations of three-dimensional representation and animation; ray tracing and path tracing rendering methods; using the graphical processing unit (GPU) for real time applications; and concludes with simulation of natural phenomenon.

**Prerequisite(s):** Bachelors degree or permission from the Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8410 DISTRIBUTED SYSTEMS AND NETWORK SECURITY (3 credits)**

The course aims at understanding the issues surrounding data security, integrity, confidentiality and availability in distributed systems. Further, we will discuss various network security issues, threats that exist and strategies to mitigate them. This course will cover topics in cryptography, public key infrastructure, authentication, hashing, digital signatures, ARP protection, IP and IPSEC, IP Tables, SSL/TLS, firewalls, etc. (Cross-listed with CYBR 8410)

**Prerequisite(s):** CSCI 8366 or equivalent(s). Not open to non-degree graduate students.

**CSCI 8420 SOFTWARE ASSURANCE (3 credits)**

Software assurance is a reasoned, auditable argument created to support the belief that the software will operate as expected. This course is an intersection of knowledge areas necessary to perform engineering activities or aspects of activities relevant for promoting software assurance. This course takes on a software development lifecycle perspective for the prevention of flaws. (Cross-listed with CYBR 8420)

**Prerequisite(s):** CSCI 8836 OR by permission of the Instructor. Not open to non-degree graduate students.

**CSCI 8430 TRUSTED SYSTEM DESIGN, ANALYSIS AND DEVELOPMENT (3 credits)**

This course examines in detail: the principles of a security architecture, access control, policy and the threat of malicious code; the considerations of trusted system implementation to include hardware security mechanisms, security models, security kernels, and architectural alternatives; the related assurance measures associated with trusted systems to include documentation, formal specification and verification, and testing, and approaches that extend the trusted system, into applications and databases and into networks and distributed systems.

**Prerequisite(s):** CSCI 8366 or equivalents, or instructor permission. Not open to non-degree graduate students.

**CSCI 8446 INTRODUCTION TO PARALLEL COMPUTING (3 credits)**

This course is an introduction to parallel computing, that is using multiple processors to execute algorithms. Topics discussed include: classification of parallel computers; shared-memory versus message passing; forms of parallelism; measures of performance; designing parallel algorithms; parallel programming and parallel languages; synchronization constructs; and operating systems for parallel computers. (Cross-listed with CSCI 4440)

**Prerequisite(s):** CSCI 4500, which may be taken concurrently, with C- or better.

**CSCI 8450 ADVANCED TOPICS IN NATURAL LANGUAGE UNDERSTANDING (3 credits)**

The course will provide in depth study of the topics in natural language processing and understanding, such as syntax, lexical and computational semantics, natural language ambiguities and their disambiguation, logical form construction and inference. The course will survey state-of-the-art natural language processing toolkits and knowledge bases that boost the development of modern language processing and understanding applications.

**Prerequisite(s):** CSCI 3320 OR CSCI 3660 OR CSCI 4450. Not open to non-degree graduate students.

**CSCI 8456 PRINCIPLES OF ARTIFICIAL INTELLIGENCE (3 credits)**

An introduction to artificial intelligence. The course will cover topics such as machine problem-solving, uninformed and informed searching, propositional logic, first-order logic, approximate reasoning, temporal reasoning, planning under uncertainty, and machine learning. (Cross-listed with CSCI 4450).

**Prerequisite(s):** CSCI 3320 with C- or better.

**CSCI 8460 FUNDAMENTALS OF ROBOTICS (3 credits)**

This course provides the core principles of robotics and the utilization of control and intelligence methodologies applied to the field of robotics. We will focus on the hands-on creation of software modules within the Robot Operating System (ROS) environment and explore how to integrate artificial intelligence techniques into a fully operational robot control system.

**Prerequisite(s):** Prior completion of undergraduate coursework in CSCI 3320 Data Structures with C- or better AND any course equivalent to this course. Basic proficiency with Python or C++ programming is recommended.

**CSCI 8476 PATTERN RECOGNITION (3 credits)**

Structures and problems of pattern recognition. Mathematics model of statistical pattern recognition, multivariate probability, Bay's decision theory, maximum likelihood estimation, whitening transformations. Parametric and non-parametric techniques, linear discriminant function, gradient-descent procedure, clustering and unsupervised learning, and feature selection algorithms. (Cross-listed with CSCI 4470)

**Prerequisite(s):** CSCI 1620 with C- or better, and MATH 2050. Recommended: MATH 4740/8746 or STAT 3800/8805.

**CSCI 8480 MULTI-AGENT SYSTEMS AND GAME THEORY (3 credits)**

This course covers advanced topics in the area of coordination of distributed agent-based systems with a focus on computational aspects of game theory. The main topics covered in this course include distributed constraint satisfaction, distributed constraint optimization, and competitive and cooperative game theory. (Cross-listed with MATH 8480)

**Prerequisite(s):** CSCI 4450 or CSCI 8456. Suggested background courses: CSCI 4480 or CSCI 8486; CSCI 8080. Not open to non-degree graduate students.

**CSCI 8486 ALGORITHMS FOR ROBOTICS (3 credits)**

This course provides an introduction to software techniques and algorithms for autonomously controlling robots using software programs called controllers. Students will be taught how to program and use software controllers on simulated as well as physical robots. (Cross-listed with CSCI 4480).

**Prerequisite(s):** CSCI 3320 with C- or better. CSCI 4450/8456 is a recommended but not essential pre-requisite.

**CSCI 8500 NUMERICAL LINEAR ALGEBRA (3 credits)**

Topics covered in this course include error propagation, solutions of nonlinear equations, solutions of linear and nonlinear systems by various schemes, matrix norms and conditioning, and computation of eigenvalues and eigenvectors. (Cross-listed with MATH 8500).

**Prerequisite(s):** MATH 1960 and MATH 2050, or permission of instructor. Familiarity with computer programming is assumed.

**CSCI 8506 OPERATING SYSTEMS (3 credits)**

Operating system principles. The operating system as a resource manager; I/O programming, interrupt programming and machine architecture as it relates to resource management; memory management techniques for uni-multiprogrammed systems; process description and implementation; processor management (scheduling); I/O device, controller, and channel management; file systems. Operating system implementation for large and small machines. (Cross-listed with CSCI 4500).

**Prerequisite(s):** CSCI 3710, CSCI 3320/8325, MATH 1950, and CSCI 4350/8356 with C- or better.

**CSCI 8510 NUMERICAL DIFFERENTIAL EQUATIONS (3 credits)**

Topics covered in this course include interpolation and approximations, numerical differentiation, numerical integration, and numerical solutions of ordinary and partial differential equations. (Cross-listed with MATH 8510).

**Prerequisite(s):** MATH 1970, MATH 2350, or permission of instructor. Familiarity with computer programming is assumed.

**CSCI 8520 ADVANCED TOPICS IN OPERATIONS RESEARCH (3 credits)**

Advanced treatment of a specific topic in the area of operations research not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with MATH 8520).

**Prerequisite(s):** MATH 4300 or MATH 8306 or CSCI 4300 or CSCI 8306 or permission of the instructor.

**CSCI 8530 ADVANCED OPERATING SYSTEMS (3 credits)**

State-of-the art techniques for operating system structuring and implementation. Special purpose operating systems. Pragmatic aspects of operating system design, implementation and use.

**CSCI 8555 COMMUNICATION NETWORKS (3 credits)**

This course is designed to bring students up to the state of the art in networking technologies with a focus on Internet. It will cover the principles of networking with an emphasis on protocols, implementations and design issues. (Cross-listed with CSCI 3550)

**Prerequisite(s):** (CSCI 3320 or CSCI 8325 with grade of C- or better) AND (CSCI 2240 or CYBR 2250 with grade of C- or better)

**CSCI 8566 NUMBER THEORY & CRYPTOGRAPHY (3 credits)**

An overview of one of the many beautiful areas of mathematics and its modern application to secure communication. The course is ideal for any student who wants a taste of mathematics outside of, or in addition to, the calculus sequence. Topics to be covered include: prime numbers, congruences, perfect numbers, primitive roots, quadratic reciprocity, sums of squares, and Diophantine equations. Applications include error-correcting codes, symmetric and public key cryptography, secret sharing, and zero knowledge proofs. (Cross-listed with CSCI 4560, MATH 4560, MATH 8566).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better or CSCI 2030 with a C- or better or permission of instructor

**CSCI 8590 FUNDAMENTALS OF DEEP LEARNING (3 credits)**

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of neural networks. Deep learning trains the machine to learn patterns that it is presented with rather than requiring the human operator to define the patterns that the machine should look for. Deep learning is behind many recent advances in artificial intelligence, such as face recognition, speech recognition and autonomous driving. This course will cover the foundations of deep learning, learning theory, basic/advanced neural networks and problem domains of many selected applications.

**Prerequisite(s):** CSCI 3320 or instructor permission

**CSCI 8610 FAULT TOLERANT DISTRIBUTED SYSTEMS (3 credits)**

This course is to study the theory and practice of designing computer systems in the presence of faulty components. Emphasizes the basics of how faults can affect systems and what is required to mask or compensate for their efforts.

**Prerequisite(s):** Not open to non-degree graduate students.

**CSCI 8620 MOBILE COMPUTING AND WIRELESS NETWORKS (3 credits)**

The objective of the course is to introduce contemporary issues in mobile computing and wireless networks. The course covers the differences between mobile computing and the traditional distributed computing paradigm, impediments of the mobile and wireless environments, problems and limitations due to such impediments, various network layers solutions, location management techniques, mobile IP, wireless LANs, wireless TCP, ad hoc networks, and sensor networks.

**Prerequisite(s):** CSCI 3550 or CSCI 8555. Not open to non-degree graduate students.

**CSCI 8626 COMPUTER GRAPHICS (3 credits)**

An introduction to the acquisition, manipulation and display of graphical information using digital techniques. Topics include discussion of the various hardware devices used for input and output, the classical algorithms and data structures used in manipulation of graphical objects, the user interface to the graphics system, and applicable standards. (Cross-listed with CSCI 4620).

**Prerequisite(s):** ISQA 3300 or CSCI 3320.

**CSCI 8656 INTRODUCTION TO CLOUD COMPUTING (3 credits)**

This course is an introduction to cloud computing. The students will learn about core concepts of cloud computing such as cloud models (IaaS, PaaS, SaaS, etc.), deployment models (public, private, hybrid), cloud infrastructures (compute, networking, storage), cloud services (VMs, serverless, object storage, cache, CDN, etc.), and big-data driven systems. This course will revisit essential topics in CS-related courses such as data structure, operating systems, and distributed systems and show how they are utilized and applied in diverse cloud computing technologies and systems including Hadoop, Spark, and distributed databases. After taking this course, students will have basic knowledge of cloud computing and hand-on experiences with diverse projects (including cloud system demos) that utilize diverse and heterogeneous cloud resources. (Cross-listed with CSCI 4650).

**Prerequisite(s):** Prior experience and background knowledge of networking and operating systems are preferred

**CSCI 8666 AUTOMATA, COMPUTABILITY, AND FORMAL LANGUAGES (3 credits)**

This course presents a sampling of several important areas of theoretical computer science. Definition of formal models of computation and important properties of such models, including finite automata and Turing machines. Definition and important properties of formal grammars and their languages. Introduction to the formal theories of computability and complexity. (Cross-listed with CSCI 4660, MATH 4660, MATH 8666).

**Prerequisite(s):** MATH 2030. Recommended: CSCI 3320/CSCI 8325.

**CSCI 8700 SOFTWARE SPECIFICATIONS AND DESIGN (3 credits)**

A continuation of the study of software engineering with an emphasis on early phases of software development, namely requirements engineering/specification and architectural design. Includes an in-depth study of practices for effective software requirements specification and architectural design, as well as formal specifications of software systems. Related topics such as metrics and support tools are also covered.

**Prerequisite(s):** CSCI 4830 or CSCI 8836. Not open to non-degree graduate students.

**CSCI 8706 COMPILER CONSTRUCTION (3 credits)**

Assemblers, interpreters and compilers. Compilation of simple expressions and statements. Analysis of regular expressions. Organization of a compiler, including compile-time and run-time symbol tables, lexical scan, syntax scan, object code generation and error diagnostics. (Cross-listed with CSCI 4700).

**CSCI 8710 MODERN SOFTWARE DEVELOPMENT METHODOLOGIES (3 credits)**

Designed to introduce students to advanced object technology and other modern methodologies for developing software systems. Intended for graduate students who have mastered the basic concepts and issues of software engineering. Course covers advanced object-oriented software development. The course also covers several offshoots of object technology, including: component-based software engineering, aspect-oriented software development, software product line engineering, service-oriented computing, etc.

**Prerequisite(s):** CSCI 4830 or CSCI 8836.

**CSCI 8760 FORMAL METHODS IN SOFTWARE ENGINEERING (3 credits)**

In the high consequence system domain, a primary objective of any construction technique employed is to provide sufficiently convincing evidence that the system, if put into operation, will not experience a high consequence failure or that the likelihood of such a failure falls within acceptable probabilistically defined limits. Systems for which such evidence can be provided are called high assurance systems. The objective of this course is to examine software-engineering techniques across the development life cycle that are appropriate for high assurance systems. The course will analyze the nature of the evidence provided by various techniques (e.g., does a given technique provide sufficiently strong evidence in a given setting).

**Prerequisite(s):** CSCI 8000 and CSCI 8836 or CSCI 4830

**CSCI 8766 TOPICS IN MODELING (3 credits)**

Selection of such topics as formulation and analysis of various models involving Markov chains, Markov processes (including birth and death processes), queues, cellular automata, difference and differential equations, chaotic systems and fractal geometries. (Cross-listed with CSCI 4760).

**Prerequisite(s):** MATH 2350 and MATH 4740 or MATH 8746.

**CSCI 8790 ADVANCED TOPICS IN SOFTWARE ENGINEERING (3 credits)**

The main objective of this course is (1) to introduce advanced topics in software engineering approaches and (2) to provide an overview and in-depth understanding of software development and maintenance techniques. Many well-known software implementation problems, associated programming tools, and analysis techniques are also covered. At the end of this course, the student should be able to apply the practical skills and approaches in solving non-trivial problems in diverse fields of study.

**Prerequisite(s):** CSCI 4830 or CSCI 8836. Not open to non-degree graduate students.

**CSCI 8836 INTRODUCTION SOFTWARE ENGINEERING (3 credits)**

Basic concepts and major issues of software engineering, current tools and techniques providing a basis for analyzing, designing, developing, maintaining and evaluating the system. Technical, administrative and operating issues. Privacy, security and legal issues. (Cross-listed with CSCI 4830).

**CSCI 8856 DATABASE MANAGEMENT SYSTEMS (3 credits)**

Basic concepts of data base management systems (DBMSs). The relational, hierarchical and network models and DBMSs which use them. Introduction to data base design. (Cross-listed with CSCI 4850).

**CSCI 8876 DATABASE SEARCH AND PATTERN DISCOVERY IN BIOINFORMATICS (3 credits)**

This required course for undergraduate bioinformatics majors provides foundational knowledge on database aspects used in the field and an overview of their applications in bioinformatics, biomedical informatics, and health/clinical informatics. The course begins with a brief review of key concepts in computational molecular biology related to database search/development, database management systems, the difference between primary and secondary databases, and bioinformatics-related aspects of modeling and theory in computer science. The major focus is on the multiple challenges and aspects of bio-database development, search, and pattern discovery. The course uses problem-based learning to help students develop database management skills as they apply to high throughput "-omics." data, the basics of data management, data provenance and governance, standards, and analysis through KDD-based workflows. This course will also consider the fundamentals of artificial intelligence and machine learning as they pertain to bioinformatics, from the perspective of database storage, I/O, and analysis. (Cross-listed with BIOI 4870)

**Prerequisite(s):** CSCI 3320 and BIOI 3500, or permission of instructor; BIOI 3500 can be taken concurrently. Prior completion of CSCI 4850 is strongly recommended but not required. Not open to non-degree graduate students.

**CSCI 8910 MASTER OF SCIENCE CAPSTONE (3 credits)**

The capstone course is to integrate coursework, knowledge, skills and experimental learning to enable the student to demonstrate a broad mastery of knowledge, skills, and techniques across the Master degree curriculum of Computer Science for a promise of initial employability and further career advancement. The course is designed to be in a student-centered and student-directed manner which requires the command, analysis and synthesis of knowledge and skills. Students may apply their knowledge and skill to a project which serves as an instrument of evaluation. Students are encouraged to foster an interdisciplinary research and cultivate industry alliances and cooperation in this course. This capstone course should be taken only after students have completed at least 3/4 of course requirements for the major.

**Prerequisite(s):** Master's degree of Computer Science with course-only option (program III). Not open to nondegree students.

**CSCI 8920 ADVANCED TOPICS COMPUTER SCIENCE (3 credits)**

An in-depth study, at the graduate level, of one or more topics that are not treated in other courses. May be repeated with different topics with permission of adviser.

**Prerequisite(s):** Permission of instructor; will vary with offering. Not open to non-degree graduate students.

**CSCI 8950 GRADUATE INTERNSHIP IN COMPUTER SCIENCE (1-3 credits)**

The purpose of this course is to provide students with opportunities to apply their academic studies in environments such as those found in business, industry, and other non-academic organizations. The student interns will sharpen their academic focus and develop better understanding of non-academic application areas.

**Prerequisite(s):** Permission of the graduate program chairperson and a minimum grade point average of 3.0 (B), with at most one grade below B, but not lower than C+ for all CS graduate classes. Not open to non-degree graduate students.

**CSCI 8960 THESIS EQUIVALENT PROJECT IN COMPUTER SCIENCE (1-6 credits)**

This course allows a graduate student to conduct a research project in computer science or a related area. The project is expected to place an emphasis on applied, implementations-based, or experimental research. The process for development and approval of the project must include: appointment of supervisory committee (chaired by project adviser), a proposal approved by the supervisory committee, monitoring of the project by the supervisory committee, an oral examination over the completed written product conducted by the supervisory committee, and final approval by the supervisory committee. The approved written project will be submitted to the Office of Graduate Studies by the advertised deadlines.

**Prerequisite(s):** Permission of Graduate Adviser. Not open to non-degree graduate students.

**CSCI 8970 INDEPENDENT STUDY (1-3 credits)**

Under this number a graduate student may pursue studies in an area that is not normally available in a formal course. The topics to be studied will be in a graduate area of computer science to be determined by the instructor.

**Prerequisite(s):** Permission of the Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8980 GRADUATE SEMINAR (1 credit)**

This course offers an up-to-date coverage of the contemporary and emerging concepts, models, techniques and methodologies, and/or the current research results in the fundamental areas of computer science. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** Permission of the Instructor. Not open to non-degree graduate students.

**CSCI 8986 TOPICS IN COMPUTER SCIENCE (3 credits)**

This is a variable topic course in computer science at the senior/graduate level. Topics not normally covered in the computer science degree program, but suitable for senior/graduate-level students can be offered. (Cross-listed with CSCI 4980).

**Prerequisite(s):** Permission of instructor. Additional prerequisites may be required for particular topic offerings.

**CSCI 8990 THESIS (1-6 credits)**

A research project, designed and executed under the supervision of the chair and approval by members of the graduate student's thesis advisory committee. In this project the student will develop and perfect a number of skills including the ability to design, conduct, analyze and report the results in writing (i.e., thesis) of an original, independent scientific investigation.

**Prerequisite(s):** Permission of Graduate Adviser. Not open to non-degree graduate students.



**CSCI 9410 ADVANCED TOPICS IN LOGIC PROGRAMMING (3 credits)**

This course will examine some advanced topics in logic programming, in particular logic programming under stable model (or answer set) semantics. Answer set programming is a common name of the field. Formal syntax, semantics, and proofs of correctness for logic programs will be considered. Elements of inductive and Prolog programming will also be introduced. Each advanced topic will be followed by how it has been applied in practice. Advanced applications of logic programming will be covered in detail.

**Prerequisite(s):** CSCI 8000 and doctoral student standing in Information Technology or the permission of the instructor.

**CSCI 9420 INTELLIGENT AGENT SYSTEMS (3 credits)**

This course covers the principles of interaction between agents in multi-agent systems using game theory. Relevant topics studied in this course include competitive games, statistical Bayesian games, cooperative games, and mechanism design. Students will have to implement projects related to the material studied in the course.

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and CSCI 4450 or CSCI 8456. Not open to non-degree graduate students.

**CSCI 9710 METHODS IN SOFTWARE ENGINEERING RESEARCH (3 credits)**

This course provides guidelines on how to conduct research in the field of software engineering by presenting the research methods, classic readings, and development of theories and their application to real life problems. The main emphasis of the course is to provide opportunity for in-depth study of topics such as contemporary methods for software development.

**Prerequisite(s):** CSCI 8836 or equivalent course and doctoral student standing in Information Technology or permission of the instructor. Not open to non-degree graduate students.

**CSCI 9810 RESEARCH FOUNDATIONS IN THEORETICAL COMPUTING (3 credits)**

This course offers an up-to-date coverage of the contemporary and emerging concepts, models, techniques, and methodologies, and/or the current research results in the fundamental areas of theoretic computing. The course will examine advanced research topics in computer science and engineering, including foundations of automata theory, computability, complexity analysis, computational logics and algorithmic analysis, hybrid dynamic systems theory, number theory, adaptation and learning theory, concepts and principles in computational geometry, stochastic processes, and random optimization. Each topic will be discussed with a perspective of research issues and directions. Active student participation in investigation of the research topics, survey of the current state-of-art, and identifying the future research insights is required. Students will take turn presenting their research results on specific topics. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** The prerequisites of this course vary depending on the areas to be covered in the semester the course is offered. Good standing in Ph.D. program is required. Permission of the instructor may be required. Not open to non-degree graduate students.

**ECON 8010 SEMINAR IN PUBLIC FINANCE (3 credits)**

This course is designed to develop the tools of applied welfare economics and to use these tools to evaluate the expenditure and tax decisions of governments. The structure, effects and reform of the U.S. individual and corporate income taxes, social security and healthcare system will be emphasized. Government debt and deficits will also be discussed.

**Prerequisite(s):** ECON 3200 or ECON 8210 or BSAD 8100 or permission

**ECON 8050 ECONOMIC EDUCATION (3 credits)**

A study and examination of economic principles and how they can be related to the teacher's classroom presentation. This course is designed to furnish the k-12 teacher with sufficient background and understanding to aid in the recognition of economic issues and the teaching of economic concepts and principles.

**Prerequisite(s):** No previous course work in economics. Not open to Economics majors.

**ECON 8080 MONEY AND FINANCIAL INSTITUTIONS (3 credits)**

This course examines the financial system (institutions, instruments, markets, practices, and public authorities), and the implementation of monetary policy that aims to maintain financial stability and support economic growth. The course discusses current events reported in the financial press and uses the analytic frameworks developed in class to analyze these issues. This course trains students to think systematically about the current state of the economy and use quantitative tools to analyze the interactions between monetary policy and the financial system.

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8200 SEMINAR IN MICRO ECONOMIC THEORY (3 credits)**

The course covers major topics in microeconomic theory. The major topics covered are the theory of consumer behavior, theory of production and cost, theory of the firm, pure exchange economy, general equilibrium, and welfare theory.

**Prerequisite(s):** ECON 3200, ECON 3220 and ECON 8306 or permission.

**ECON 8210 APPLIED MANAGERIAL ECONOMICS (3 credits)**

This is a course in empirical economic modeling techniques deployed by economists and other business consultants use in business and public policy applications. There are four main themes: 1) techniques used in demand analysis and economic forecasting, 2) techniques used in production and cost analysis, 3) supply chain and trade analysis, and 4) analysis and measurement of competitive interactions.

**Prerequisite(s):** ECON 2200 or equivalent, or permission of the instructor.

**ECON 8216 INDUSTRIAL ORGANIZATION (3 credits)**

In this class we will examine why firms and industries behave the way that they do. We will explore why some industries face intense competition while others enjoy large profits, why some industries offer only bundles, and why some firms buy up their supply chain when others do not. This theoretical course will illuminate un-theoretical implications to your life and future business ventures. This course will use your economic knowledge, a bit of psychology (behavioral economics) and game theory to answer questions like "Why does everyone hate the cable company?" and "Why are CEOs given so many stock options?" (Cross-listed with ECON 4210).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8220 SEMINAR IN MACRO THEORY (3 credits)**

This course traces the development of macroeconomic theory from the classical point of view to current schools of thought. Keynesian, neo-Keynesian and neo-classical models are developed.

**Prerequisite(s):** ECON 3200 or ECON 8210 or BSAD 8100, ECON 3220, and ECON 8306, or permission.

**ECON 8230 BUSINESS CONDITIONS ANALYSIS (3 credits)**

This course is concerned with the statistical measurement and evaluation of general business conditions, as well as the adaptation of business policies to changing business conditions. Emphasis is placed upon the practical application of statistical analysis techniques to business situations within the framework of the aggregate economy.

**Prerequisite(s):** ECON 2200 and ECON 2220.

**ECON 8246 LABOR ECONOMICS (3 credits)**

The course will cover essential topics in Labor Economics including factors leading to equilibrium conditions in the labor market, human capital accumulation, discrimination in the workplace, compensation for undesirable work, mobility, unionization, and more. (Cross-listed with ECON 4240).

**Prerequisite(s):** ECON 2200 OR BSAD 8150 OR Instructor Approval

**ECON 8256 SPORTS ECONOMICS (3 credits)**

Economics is frequently considered an abstract topic, with interesting results that are not easily applied in the real world. Through Sports Economics, students will explore the very real ways in which economics influences sporting competitions and the businesses surrounding them. Students will explore topics such as unionization in sports, discrimination, amateurism, monopoly power, game theory, and more in the context of sports, giving the student a deeper understanding of how these topics apply to real-world problems. After this course, students will understand how readily economics can be applied to businesses and problems in any industry or domain. (Cross-listed with ECON 4770).

**Prerequisite(s):** ECON 2200 OR BSAD 8150 OR Equivalent OR Instructor Approval. Not open to non-degree graduate students.

**ECON 8290 RESEARCH METHODS IN ECONOMICS AND BUSINESS (3 credits)**

Covers the methodology of economics: choosing a research topic, literature search tools, data source identification, data summary techniques, basic statistical data analysis using statistical packages, and clear economics writing. The student will become familiar with these techniques through text materials, journal studies, and completion of an empirical economics paper.

**Prerequisite(s):** ECON 3200, ECON 3220, or equivalents, or permission of the instructor. Not open to non-degree graduate students.

**ECON 8300 ECONOMETRICS (3 credits)**

The study of the underlying assumptions, techniques and applications of single and multiple equation regression analysis in economics.

**Prerequisite(s):** Basic Statistics, ECON 8306/ECON 4300, or permission. Not open to non-degree graduate students.

**ECON 8306 QUANTITATIVE APPLICATIONS IN ECONOMICS AND BUSINESS (3 credits)**

The study and application of modern quantitative techniques to problem-solving in economics and business. It is designed to help the student to translate verbal arguments in economics and business into their mathematical equivalents, to improve analytical skills, and to attain proficiency in marginal analysis, equilibrium analysis, static optimization, and comparative statics analysis. It covers topics such as exponential and logarithmic functions and their applications, linear algebra and its applications, derivatives and their applications, maximization of functions with one variable and multi variables, maximization with non negativity constraints, and integral calculus and its applications in economics and business. (Cross-listed with ECON 4300).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180.

**ECON 8310 BUSINESS FORECASTING (3 credits)**

The course will cover forecasting tools and applications applied to business settings. The first half of the course will cover traditional Econometric forecasting methods and the second half of the course will focus on predictive analytics models and machine learning. Time in the computer lab will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with BSAD 8080).

**Prerequisite(s):** ECON 8320 (or equivalent programming experience) or permission of instructor. Not open to non-degree graduate students.

**ECON 8316 BUSINESS INTELLIGENCE AND REPORTING (3 credits)**

The course will teach students to use state-of-the-art Business Intelligence (BI) software to generate reports and information from data. BI software is used to inform decision-making in industries from transportation to medicine, from marketing to government, and is facilitated by rapidly increasing access to data in all industries. Students will learn to employ best practices in visualization and verbal communication as they are trained to create valuable insights from data and convey those insights to stakeholders. Additionally, the course will aid students in preparing for certification in the use of state-of-the-art BI software. (Cross-listed with ECON 4350).

**Prerequisite(s):** BSAD 2130 (or equivalent) OR Instructor Approval

**ECON 8320 TOOLS FOR DATA ANALYSIS (3 credits)**

The course will cover basic principles of programming languages, as well as libraries useful in collecting, cleaning and analyzing data to answer research questions. The course will utilize basic Economic principles and Econometric methods as inspiration for assignments and projects throughout the duration of the course, and will do so in a way that is accessible to non-Economists. This course is intended to introduce the student to the Python programming language as a tool for conducting data analysis. While the course uses Python, the student should be able to move to other languages frequently used in data analysis using the principles taught in this course.

**Prerequisite(s):** BSAD 2130 or equivalent; or instructor approval.

**ECON 8326 NATURAL RESOURCE ECONOMICS (3 credits)**

This course introduces students to the economics and management of Earth's natural resources. We address questions such as: Are we running out of natural resources? Are we using resources in a sustainable fashion? What role do markets play in resource use? We will address issues related to fossil-based resources, minerals, fisheries, water, land, forests and other associated topics. The course covers the basic theoretical framework for understanding the optimal rate of resource use, identifies the factors that determine the actual rate of use, and considers and evaluates various public policy prescriptions. (Cross-listed with ECON 4320).

**Prerequisite(s):** ECON 2200 and ECON 2220, BSAD 8150 or permission of instructor.

**ECON 8330 DATA ANALYSIS FROM SCRATCH (3 credits)**

Econometrics is routinely taught as an application class using a 'black box' like Stata or SAS to perform calculations. This class takes a different approach. Using the Python programming language, we build all estimators from scratch. Additionally, we introduce numerous non-parametric and simulation techniques. This approach to econometrics results in a stronger understanding of statistical assumptions and methods, a better understanding of when a method is appropriate, and stronger programming techniques. Furthermore, a deeper understanding of the underlying mechanics provides the student the ability to program custom procedures not already built into popular software packages. As part of the course, students will work with a community partner to answer a real question with data; MBA students should consult with their advisor about this course satisfying the project-focused capstone requirement.

**Prerequisite(s):** A multivariate or regression analysis course such as ECON 8300, ISQA 9130 or STAT 8436, and a programming class such as ECON 8320 or equivalent programming experience; or instructor approval. Not open to non-degree graduate students.

**ECON 8336 ENVIRONMENTAL ECONOMICS AND SUSTAINABILITY (3 credits)**

In this course students will apply economic concepts and models to environmental concerns and policy solutions that combat environmental degradation. Topics include: Air and water pollution, solid waste management, carbon taxation, cap-and-trade systems, and economic motivations for sustainable business management. (Cross-listed with ECON 4330).

**Prerequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor.

**ECON 8346 ECONOMICS OF TECHNOLOGY (3 credits)**

Innovative dynamism is the economic system which brings us the new goods and processes that make life longer and better. We will examine how the system works, including: The role of the breakthrough inventor and the innovative entrepreneur; whether the system improves or hurts ethical behavior, culture, equality, and the environment; the costs to workers in terms of job loss, and the benefits to workers in terms of the creation of better jobs; how funding, regulatory, and patent policies affect innovative dynamism; and how innovative dynamism in medicine can result in more and faster cures for cancer and other diseases. (Cross-listed with ECON 4340).

**Prerequisite(s):** ECON 2200 or BSAD 8180 or permission of the instructor.

**ECON 8456 DOMESTIC MONETARY THEORY AND POLICY (3 credits)**

The course will introduce students to topics in money and banking, financial institutions, markets, financial instruments, and monetary theory in order to enhance financial decision making and enable students to effectively analyze economic news in media such as the Wall Street Journal, The New York Times, Business Week, Barrons, The Economist, and other related business publications. This knowledge will enable students to formulate their own views about the current economic environment, government policies, and responses to economic environments. (Cross-listed with ECON 4450).

**ECON 8576 ECONOMIC CONDITIONS ANALYSIS (3 credits)**

This course teaches students how to conduct an economic analysis of, and produce an economic forecast for, a local economy such as a state, county, or metropolitan area. Students will learn where to find data, how to analyze that data, how to develop models with the data, and how to present the data in a clear, concise, and jargon-free manner. The final published report will be authored by the students registered in the course. All students will contribute equally to the final report. The instructor will ensure equal participation. (Cross-listed with ECON 4570).

**Prerequisite(s):** ECON 2200 and ECON 2220, or Permission from the instructor

**ECON 8616 INTERNATIONAL TRADE (3 credits)**

An analysis of the character of international economic relations. Subjects covered include the economic basis for international specialization and trade, the economic gains from trade, commercial policy, economic integration and economic growth. (Cross-listed with ECON 4610).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8626 INTERNATIONAL MONETARY THEORY (3 credits)**

This course is designed to introduce students to topic areas in International Macroeconomics and International Finance. Students will examine the mechanisms of the foreign exchange market, and how exchange rates are determined in the short-run as well as in the long-run. Students will investigate the different exchange rate regimes around the world, including fixed exchange rates, floating exchange rates, crawling pegs, and other arrangements. Students will examine the European Union and ask whether such a system is economically viable. This is especially important in the current economic environment facing Europe. Students will also examine exchange rate crises over history, and examine how they all have common elements. (Cross-listed with ECON 4620).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8666 INTERNATIONAL ECONOMIC DEVELOPMENT (3 credits)**

This course introduces theories and application of economic development and growth, economic problems facing developing countries, analyzes domestic economic issues (e.g., per capita GDP, income distribution, population, unemployment, urbanization, education, fiscal policies, and financial policies), and international economic issues (e.g., trade, foreign investment, and foreign debt). Financial crises, debt crises, and economic recovery will be discussed. (Cross-listed with ECON 4660).

**Prerequisite(s):** ECON 2200 and ECON 2220, or BSAD 8180, or permission of instructor.

**ECON 8736 ECONOMICS OF ENTREPRENEURSHIP (3 credits)**

This course will review economic theories of entrepreneurship with special emphasis on Schumpeter's theory of creative destruction. The main focus of the seminar will be on the "high-level" entrepreneurship that sometimes results in major innovations. This course will address the societal benefits of entrepreneurship, factors influencing entrepreneurial success, the policies that best encourage entrepreneurship, and how firms can survive and prosper in an entrepreneurial environment. (Cross-listed with ECON 4730, BSAD 8736.)

**Prerequisite(s):** ECON 2200 or permission of the instructor for all students.

**ECON 8856 ECONOMICS OF URBAN AND REGIONAL DEVELOPMENT (3 credits)**

This course will consider factors and trends in development at the global and national level but will focus primarily on economic development at the state, local, and regional levels in the United States. The focus of this course will be real world strategic planning for economic development. (Cross-listed with ECON 4850).

**Prerequisite(s):** MATH 1310 or MATH 1220, ECON 2200 and ECON 2220, each with a "C" (2.0) or better, or permission of instructor.

**ECON 8910 SPECIAL STUDIES IN ECONOMICS (3 credits)**

This course will focus on issues or developments in a specific area of economics or business.

**Prerequisite(s):** Graduate student in good standing and as indicated for specific workshop or seminar.

**ECON 8920 INDEPENDENT STUDY (1-3 credits)**

Guided independent study and research.

**Prerequisite(s):** Graduate student in economics and permission of instructor.

**ECON 8940 ECONOMIC INTERNSHIP (1-3 credits)**

Guided internship in a firm or organization that makes use of, or extends, the student's skill in economics.

**Prerequisite(s):** Completion of at least nine hours of graduate level economics and permission of instructor.

**ECON 8990 THESIS (1-6 credits)**

An independent research project, written under the supervision of a graduate adviser in the department of economics. Approval of the topic and the completed project by departmental committee is required.

**Prerequisite(s):** Approval of the topic and the completed project by departmental committee is required.

**ISQA 8016 BUSINESS INTELLIGENCE (3 credits)**

This course intends to provide graduate students in-depth exposure to the growing field of business intelligence. Business intelligence (BI) consists of the set of concepts and techniques used to analyze business data in support of decision-making and planning. BI spans a number areas of management information systems, including Decision Support Systems (DSS), Enterprise Resource Planning (ERP), Data Warehousing, Knowledge Management, Customer Relationship Management, Data Mining, and others.

**Prerequisite(s):** (ISQA 4150 or ISQA 8156) and ISQA 8040 and ISQA 8050. Not open to non-degree graduate students.

**ISQA 8030 INFORMATION SYSTEMS AND ETHICS (3 credits)**

This course gives you an introduction to organizations and the role that information and information systems play in supporting an organization's operations, decision-making processes, quality management, and strategic activities. The course provides an introduction to the management of information systems function, the strategic and regulatory issues of telecommunications, and ethical and legal issues related to information systems.

**Prerequisite(s):** Admission into the MS in MIS program.

**ISQA 8040 AN OVERVIEW OF SYSTEMS DEVELOPMENT (3 credits)**

The course presents an overview of the systems development lifecycle and database development. The course will focus on theory, current tools and techniques that the system developer can use to develop and document information systems. The purpose of this course is to prepare the student for further graduate-level study of information systems. This course may not be used in a plan of study for any graduate program at UNO.

**ISQA 8050 DATA ORGANIZATION AND STORAGE (3 credits)**

The course will provide concepts of data organization, data storage, and data transfer through computer networks. The performance implications of various design decisions will be explored. The purpose of this course is to prepare the student for further graduate-level study of information systems. This course may not be used in a plan of study for any graduate program at UNO.

**ISQA 8060 RESEARCH IN MIS (3 credits)**

This course covers research methods and their application to the development and evaluation of management information systems. Also covered is the relationship between organization theory and IS research.  
**Prerequisite(s):** CIST 2500, CIST 2100, and ISQA 8040, or permission of the instructor.

**ISQA 8070 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (1 credit)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**ISQA 8080 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (3 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** 1) Permission of the instructor. 2) Additional prerequisite courses may be required for particular course offerings.

**ISQA 8086 SPECIAL TOPICS: INFORMATION SYSTEMS & QUANTITATIVE ANALYSIS (1-5 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once. (Cross-listed with ISQA 4000)

**Prerequisite(s):** Permission of instructor. Additional prerequisites may be required for particular topic offerings.

**ISQA 8090 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (2 credits)**

This course is designed to acquaint students with issues which are current to the field or harbingers or emerging trends in the information systems area. Topics will vary across terms. This course may be repeated, but no topic may be taken more than once.

**Prerequisite(s):** Permission of the instructor. Additional prerequisite courses may be required for particular course offerings.

**ISQA 8106 INFORMATION SYSTEMS ARCHITECTURE AND ORGANIZATION (3 credits)**

This course examines the frameworks and tools used to develop an organization's information system architecture. It provides the analytical skills and conceptual frameworks with which to make recommendations and decisions regarding the integration of information technology components into an information system architecture. (Cross-listed with ISQA 4100)

**Prerequisite(s):** CIST 2100 and ISQA 3310

**ISQA 8136 INFORMATION TECHNOLOGY FOR DEVELOPMENT (3 credits)**

Information Technology for Development (ITD) is the implementation and evaluation of information technology infrastructures to stimulate economic, social and human development. In this service-learning course, students will learn and apply ITD concepts for developing and adding value through IT by working with small business entrepreneurs in Omaha or rural Nebraska. Students will evaluate micro-business technology needs, prepare business technology plans, provide training, and implement appropriate solutions, to the extent possible within a semester class. (Cross-listed with ISQA 4130)

**Prerequisite(s):** Though not required, the following courses or their equivalent would provide the necessary background : CIST 1100, CIST 1300, ISQA 3210, ISQA 3310, ISQA 3400. Not open to non-degree graduate students.

**ISQA 8156 ADVANCED STATISTICAL METHODS FOR IS&T (3 credits)**

This course emphasizes the application and interpretation of statistical methods including design of experiments, analysis of variance, multiple regression, and nonparametric procedures and the use of statistical computer packages. The intent is to develop quantitative abilities needed for quantitatively intensive jobs and for advanced study in management information systems, computer science and information technology. (Cross-listed with ISQA 4150)

**Prerequisite(s):** CIST 2500 or equivalent (at least one course in statistics)

**ISQA 8160 APPLIED DISTRIBUTION FREE STATISTICS (3 credits)**

The primary objective of this course is to expose students to methods of analyzing data from non-normal populations including binomial tests, contingency tables, use of ranks, Kolmogorov-Smirnov type statistics and other selected topics.

**Prerequisite(s):** Admission to MS program in Management Information Systems or permission of instructor. This course assumes prior knowledge with basic descriptive and inferential statistics from an introductory undergraduate course (e.g., CIST 2500).

**ISQA 8166 ENTERPRISE RESOURCE PLANNING SOFTWARE CONSULTING (3 credits)**

Enterprise Resource Planning (ERP) consulting is designed to provide students foundational knowledge required to become a consultant working with enterprise systems. ERP systems are used by most organizations to manage and integrate the core functions of a business. Students will be exposed to a broad range of consulting skills that spans package selection to the implementation process. Students will work with a live instance of an ERP system focusing on the cross-functional integration of core business processes primarily in a manufacturing environment including finance, operations/supply chain, procurement, and fulfillment. The goal of the course is to provide students a foundation for careers in the area of ERP systems and consulting. (Cross-listed with ISQA 4160, SCMT 4160)

**ISQA 8176 DIGITAL SUPPLY CHAIN & LOGISTICS (3 credits)**

Global Supply Chains are being disrupted by digital transformation driven by emerging technologies such as IoT (internet of things) and AI/ML (Artificial Intelligence/Machine Learning). This course will take a closer look at global supply chains and logistics with an emphasis on the impact of digitalization. We will explore the typical global supply chain processes and how state-of-the-art and emerging technologies impact them. Thus, the class views global digital supply chains by integrating business and technological perspectives. The course will start with an overview of technologies relevant to digital supply chains. We will then discuss digitalization strategy and digital supply chains, fundamental GSCM (Global Supply Chain Management) processes and their potential for digitalization, and discussion of IT/software systems, IoT, AI/ML, Data Analytics/Visualization, and related facets that impact digital supply chains. The course will culminate with an integrated case study and/or research paper (graduate). (Cross-listed with ISQA 4170).

**Prerequisite(s):** It is preferable that students have taken an introductory supply chain class or have some experience in the transportation, logistics and supply chain management sector.

**ISQA 8180 ELECTRONIC COMMERCE (3 credits)**

Electronic Commerce is the digital enablement of transactions between multiple parties. A multitude of technologies, tools and applications have brought about changes in business, and society that require careful consideration. Students are given an overview of electronic commerce business models and required to apply these to solve business problems or take on opportunities presented. They will cover topics such as social networking, electronic markets, and political and ethical issues associated with electronic commerce, and business plans for technology ventures. They will apply these concepts using Web 2.0 tools, mobile applications and website design assignments.



**ISQA 8196 PROCESS REENGINEERING WITH INFORMATION TECHNOLOGY (3 credits)**

Business process reengineering issues are examined. Reengineering concepts and methods are introduced. Additional special project(s) are required. SAP will be introduced. (Cross-listed with ISQA 4190)

**Prerequisite(s):** CIST 2500; prerequisite/co-requisite ISQA 4110.

**ISQA 8206 INFORMATION AND DATA QUALITY MANAGEMENT (3 credits)**

The course primarily focuses on developing an in-depth understanding of Data and Information Quality (DQ and IQ) concepts and issues. On completing this course students will be able to understand and use DQ and IQ Concepts in Information Systems projects, be able to recognize various patterns of Data and Design Deficiencies in Systems and be able to suggest appropriate DQ and IQ improvement plans in light of known deficiencies in systems. (Cross-listed with ISQA 4200)

**Prerequisite(s):** CIST 2500

**ISQA 8210 MANAGEMENT OF SOFTWARE DEVELOPMENT (3 credits)**

This course should encourage you to think critically about aspects of software development that make it difficult and strategies to mitigate these challenges. This course integrates concepts from software engineering, management science, psychology, and organizational behavior to identify, understand, and propose solutions to problems associated with software development. We examine and consider issues from various perspectives, such as the project manager, development team, senior management, and project sponsor. This course prepares students for various roles within a software development effort including leadership positions in software development. Students will practice software project management and agile methods of managing projects in a semester long team project using contemporary project and development methods.

**Prerequisite(s):** Admitted to MS in MIS or instructor permission. Prior knowledge assumed in SW development & relational databases - ISQA 8040/ISQA 4110 & ISQA 3310/equivalent and in web development - ISQA 3900/equivalent. Not open to non-degree graduate students.

**ISQA 8220 ADVANCED SYSTEMS ANALYSIS AND DESIGN (3 credits)**

This course is a systems analysis and design course for systems and business analysts. The course presents an overview of object-oriented system analysis and design. The course will then focus on theory, best practices, and modern methodologies that analysts can use to analyze and design information systems.

**Prerequisite(s):** ISQA 8040 or (ISQA 4110 and ISQA 4120) or equivalent and ISQA 8050 or ISQA 3310 or equivalent

**ISQA 8306 DATABASE ADMINISTRATION (3 credits)**

This course is designed to give students an applied, practical introduction to database administration. Students will gain an understanding of the functioning of a database management system and its relationship to the computing environment in which it runs. They will learn the concepts, principles, and techniques necessary to carry out such functions as database object creation, storage management, capacity planning, performance tuning, backup and recovery, and security management. Each semester the course will focus on one commercial database management system (DBMS), such as Oracle. (Cross-listed with ISQA 4300)

**Prerequisite(s):** ISQA 8040 or ISQA 3310 or CSCI 4850. Not open to non-degree graduate students.

**ISQA 8310 IT INFRASTRUCTURE & CLOUD COMPUTING (3 credits)**

This course provides a graduate-level introduction to the business and technical decisions around technical infrastructure. It covers topics related to computer and systems architecture and communications networks, with a focus on the technical and business decisions around technology. Students completing the course will be able to understand and design network infrastructure, evaluate cloud computing offerings, and communicate their decisions. The course covers hardware, software, and cloud computing technologies.

**ISQA 8340 APPLIED REGRESSION ANALYSIS (3 credits)**

The primary objective of this course is to expose students to regression models and applications with particular emphasis on applying these concepts to IT research. Topics to be discussed include: Foundations of regression analysis using least squares procedures; model formulation, stepwise regression, transformations; graphical methods, estimation; inference; influence diagnosis; matrix formulation, multicollinearity, time series, and nonlinear models.

**Prerequisite(s):** ISQA 4150 or ISQA 8156, not open to non-degree graduate students.

**ISQA 8380 ENTERPRISE ARCHITECTURE AND SYSTEMS INTEGRATION (3 credits)**

This course is designed to give students grounding in the concepts, issues, and tools needed to manage enterprise architecture, distributed systems & Internet-based environments. The goal of the course is to equip students to make the architecture and infrastructure-related decisions needed for successful development and use of contemporary client/server and Internet-based systems. Topics include middleware, architecture, XML, JSON, web services, service-oriented architecture, enterprise application integration, distributed computing services, Model View Controller (MVC) development frameworks.

**Prerequisite(s):** ISQA 8310 and ISQA 8050 or equivalent; permit required.

**ISQA 8410 DATA MANAGEMENT (3 credits)**

The course provides in-depth coverage of such areas as: the relational model, SQL, data modeling, data quality management, database design, data warehousing, business intelligence, document and content management, NoSQL systems, and data governance. The course offers a mix of theoretical treatment and hands-on application. Current DBMS and data modeling software will be used.

**Prerequisite(s):** ISQA 8050 or equivalent, permit only.

**ISQA 8420 MANAGING THE I.S. FUNCTION (3 credits)**

The course provides a focus on the business management implications of the information explosion. The course is organized around a management audit of the information services activity to help present and future managers recognize and implement effective information services management.

**Prerequisite(s):** CIST 2100 and ISQA 8040. Not open to non-degree graduate students.

**ISQA 8450 NOSQL AND BIG DATA TECHNOLOGIES (3 credits)**

The course will cover topics in the area of NoSQL and Big Data management. The course is intended to get students familiarized with NoSQL and Big Data technologies, explore how these database technologies differ conceptually from traditional relational database technologies, understand their applications, uses, advantages, and disadvantages, and provide hands-on experience with NoSQL and Big Data databases. The course offers a mix of theoretical treatment and hands-on application of the discussed NoSQL and Big Data technologies.

**Prerequisite(s):** Prior exposure to data management is expected. The prereq is: ISQA 3310, ISQA 8040, CSCI 4850, or work experience that has given you a comparable grounding in database concepts and technologies; in this case permission by the instructor is needed.

**ISQA 8460 INTERNET OF THINGS (IOT), BIG DATA AND THE CLOUD (3 credits)**

This course introduces the Internet of Things (IoT). It provides an overview of a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. In the future, the "Things" in question may have identities and virtual personalities, operating in smart spaces using intelligent interfaces to connect and communicate with the social, environmental, and user context.

**Prerequisite(s):** Basic Web Development using HTML/CSS and some MVC framework. The equivalent of two semester exposure to programming.

**ISQA 8525 GRAPHICAL USER INTERFACE DESIGN (3 credits)**

This course is an introduction to interaction design with a primary emphasis on designing usable and useful computer interfaces. Students will learn the principles of interface design grounded in a fundamental understanding of human cognitive processes. They will learn how end-users develop and use mental models of interaction and will apply this knowledge to the design of interfaces for real-world applications. A design project will challenge students to plan their own designs, to develop interfaces and to integrate them into a working application prototype, to test their application with real users, and to effectively communicate the overall results. (Cross-listed with ISQA 3520)

**Prerequisite(s):** CIST 1300

**ISQA 8546 COMPUTER SECURITY MANAGEMENT (3 credits)**

The purpose of this course is to integrate concepts and techniques from security assessment, risk mitigation, disaster planning, and auditing to identify, understand, and propose solutions to problems of computer security and security administration. (Cross-listed with CIST 4540, CYBR 4540, CYBR 8546)

**Prerequisite(s):** CYBR 4360 or permission of the instructor.

**ISQA 8560 INFORMATION WARFARE AND SECURITY (3 credits)**

This course will study the nature of information warfare, including computer crime and information terrorism, as it relates to international, national, economic, organizational, and personal security. Information warfare policy and ethical issues will be examined.

**Prerequisite(s):** CIST 2100 or BSAD 8030 or ISQA 8030, or permission of instructor required.

**ISQA 8570 INFORMATION SECURITY POLICY AND ETHICS (3 credits)**

The course will cover the development and need for information security policies, issues regarding privacy, and the application of computer ethics. (Cross-listed with IASC 8570)

**Prerequisite(s):** CIST 2100 or BSAD 8030, or permission of instructor.

**ISQA 8580 SECURITY RISK MANAGEMENT AND ASSESSMENT (3 credits)**

The purpose of this course is to prepare the student for managing information security at the organizational level. This course will combine concepts from strategic management, decision science and risk analysis to prepare the student to integrate security issues into an organizational strategic planning process.

**Prerequisite(s):** CIST 2100 or ISQA 8030. Not open to non-degree graduate students.

**ISQA 8600 FROM DATA TO DECISIONS (3 credits)**

This course focuses on inquiry-driven data preparation and exploratory analysis skills for audience-driven, decision-oriented data analysis. Students gain experience in data evaluation, cleaning, documentation, and exploration with basic descriptive statistics and visualizations.

**ISQA 8700 DATA MINING: THEORY AND PRACTICE (3 credits)**

This course provides students theoretical issues as well as practical methods for conducting data mining process, including the implementation of a warehouse. After covering the essential concepts, issues, techniques to build an effective data warehouse, this course emphasizes the various techniques of data mining, such as association, classification, clustering and prediction for on-line analyses within the framework of data warehouse architectures. This course also promotes students to conduct a real-life data analyzing project in Big Data Era.

**Prerequisite(s):** ISQA 8050 and ISQA 8310 and ISQA 8040, not open to non-degree graduate students.

**ISQA 8720 APPLIED STATISTICAL MACHINE LEARNING (3 credits)**

This course focuses on advanced techniques in the analysis and evaluation of data, using both supervised and unsupervised methods. It covers the main types of statistical learning models needed for complex data analytics problems, as well as aspects of model development and optimization.

Topics include: Linear and Non-Linear Regression Models, Classification, Resampling Methods, Model Selection and Regularization, Decision Trees, Model Boosting and Bagging, Support Vector Machines, and Clustering methods. This is an applied, hands-on course that will use a state-of-the-art statistical tool to implement the discussed approaches in assignments and a course project and focuses on the understanding and application of the concepts.

**Prerequisite(s):** ISQA 8156 (B-grade or better) and the following topics: The equivalent of two classes of statistics and/or advanced mathematics and a minimum of one semester of applying R in courses and/or projects

**ISQA 8736 DECISION SUPPORT SYSTEMS (3 credits)**

This course examines a set of information systems which specifically support managerial decision makers: Decision Support Systems, Group Decision Support Systems, Executive Information Systems, Data Warehouses, Expert Systems, and Neural Networks. This course explores the development, implementation, and application of these systems, how these systems can be applied to current business problems, as well as how organizational issues impact the implementation and usage of these systems. (Cross-listed with ISQA 4730)

**Prerequisite(s):** ISQA 8030 or equivalent.

**ISQA 8750 STORYTELLING WITH DATA (3 credits)**

This course provides an in-depth study of how to build a compelling story using data for business professionals to make winning arguments, it provides an overview of a number of technologies and research disciplines that enabled the power of data visualization. Data visualization is critical to managing large volumes of data, and can be defined as the science (analytical) and art (design) of manipulating and presenting data for expression and cognitive recognition. Data visualization involves using data in a way that humans can clearly understand, supporting efforts by organization to gain competitive advantage by changing operations, decision-making, and strategic initiatives.

**Prerequisite(s):** CSCI 1620 or equivalent. Admission into the UNO graduate program, basic web development or work experience with comparable grounding in programing, scripting concepts & technologies and permission by the instructor is needed.

**ISQA 8810 INFORMATION TECHNOLOGY PROJECT FUNDAMENTALS (3 credits)**

The course will integrate concepts and techniques from management science, psychology, organizational behavior, & administration change to identify, understand & propose solutions to the problems of project management. The purpose of the course is to prepare the graduate for project participation and leadership.

**Prerequisite(s):** CIST 2100 and ISQA 8040. Not open to non-degree graduate students.

**ISQA 8820 PROJECT RISK MANAGEMENT (3 credits)**

This course will cover project risk management, i.e., the process of measuring or assessing risk in projects and then developing strategies to manage the risk. The topics covered will include: Risk Management Planning, Risk Identification, Quantitative Risk Analysis, Qualitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control will be covered in detail. Students will learn how to apply and use the tools and techniques needed to perform these project management tasks. A collection of readings on risk management from the empirical literature coupled with risk management standards from organizations such as IEEE and the Project Management Institute (PMI) will be used to provide the student with an excellent foundation in risk management and control.

**Prerequisite(s):** ISQA 8810 or permission of instructor.

**ISQA 8900 INDEPENDENT RESEARCH IN MANAGEMENT INFORMATION SYSTEMS (1-3 credits)**

The content of the course will vary. However, both the student and the faculty member must sign an Independent Research Agreement and file it with the Master of Science in Management Information Systems Graduate Program Committee before registration for the course. This agreement will detail the project, the schedule for its completion, the form of the output, the method of evaluation and other relevant information pertaining to the project.

**Prerequisite(s):** Permission of instructor, and at least 12 hours of course work toward a M.S. in MIS should be completed.

**ISQA 8910 INFORMATION SYSTEMS INTERNSHIP (1-3 credits)**

Information Systems Internship provides students with an opportunity for practical application and further development of knowledge and skills acquired in the MS MIS degree program. The internship gives students professional work experience and exposure to the challenges and opportunities faced by IT professionals in the workplace.

**Prerequisite(s):** Permission of the instructor required. Students must have completed a minimum of 18 credit hours towards the MS MIS program. Not open to non-degree graduate students.

**ISQA 8950 CAPSTONE MANAGEMENT INFORMATION SYSTEMS (3 credits)**

The course consists of a student executed Information Systems design project providing an in-depth practical experience. It typically covers system conceptualization, analysis, and design. It may also involve prototyping. The project will typically not include the actual implementation of the system. This course replaces the MS in MIS comprehensive exam requirement.

**Prerequisite(s):** Students must have 6 credit hours or fewer left in the program. Students must have completed all core classes. Not open to non-degree graduate students.

**ISQA 8990 THESIS (1-6 credits)**

This course is a research project designed and executed under supervision of a thesis supervisory committee. Student will develop skills, including the ability to design, conduct, analyze, and report results in writing (i.e., thesis) of an original, independent, scientific investigation. The student's thesis supervisory committee must approve the project plan.

**Prerequisite(s):** ISQA 8060 research methods or equivalent. Graduate major in MIS and approval of the thesis supervisory committee. Not open to non-degree graduate students.

**ISQA 9010 FOUNDATIONS OF INFORMATION SYSTEMS RESEARCH (3 credits)**

This course covers the following areas: (1) information systems as an academic discipline including classic readings in IS and its reference disciplines, (2) theory development and evaluation, (3) research methods applicability in IS.

**Prerequisite(s):** Doctoral student standing in the information systems areas or with the permission of the instructor; ISQA 8060 or equivalent. Not open to non-degree graduate students.

**ISQA 9020 TECHNICAL AND PROCESS ISSUES IN INFORMATION SYSTEMS RESEARCH (3 credits)**

This seminar is a survey course on the technical and process issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in technical and process issues with the application of that knowledge to research on information systems. Major topics include: software engineering, programming, data base systems, decision support systems, data warehousing and mining systems, object-oriented systems, adaptive and expert systems, client-service systems, information filtering and multimedia systems, information agents, mobile computing, telecommunications, and electronic commerce.

**Prerequisite(s):** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree graduate students.

**ISQA 9030 BEHAVIORAL AND ORGANIZATIONAL ISSUES IN INFORMATION SYSTEMS (3 credits)**

This seminar is a survey course on behavioral and organizational issues in information systems research. The course balances the acquisition of knowledge about the conduct of research in behavioral and organizational issues with the application of that knowledge to research on information systems. The course is intended for doctoral students in Information Technology or related areas.

**Prerequisite(s):** Doctoral student standing in the information systems area or with the permission of the instructor; ISQA 9010 is recommended. Not open to non-degree graduate students.

**ISQA 9120 APPLIED EXPERIMENTAL DESIGN AND ANALYSIS (3 credits)**

Constructing and analyzing designs for experimental investigations; completely randomized, randomized complete block and Latin-square designs, split-plot designs, incomplete block designs, confounded factorial designs, nested designs, and treatment of missing data, comparison of designs. The course will use computer-assisted analysis and graphic techniques included in software such as Statistical Analysis Software (SAS) or Statistical Package for Social Sciences (SPSS) or R (a programming language that provides a wide variety of statistical and graphical techniques. Similar to the S language).

**Prerequisite(s):** ISQA 4150 or ISQA 8156 or consent of instructor. Not open to non-degree graduate students.

**ISQA 9130 APPLIED MULTIVARIATE ANALYSIS (3 credits)**

The use of multivariate analysis for solving business problems. Multivariate Analysis of Variance (MANOVA), factor, cluster, and discriminant analysis techniques in IT research. The course will use computer-assisted analysis and graphic techniques included in software such as Statistical Analysis Software (SAS) or Statistical Package for Social Sciences (SPSS) or R (A programming language that provides a wide variety of statistical and graphical techniques. Similar to the S language).

**Prerequisite(s):** ISQA 4150 or ISQA 8156 or consent of instructor. Not open to non-degree graduate students.

**ISQA 9150 RESEARCH IN INFORMATION TECHNOLOGY (3 credits)**

Research methods in Information Technology involves an overview of the research process specific to problems in IT. Students will learn about theories in IT relevant to their areas of research. They will identify key components of research problems in IT, understand different types of research processes, develop research questions, and design research projects. They will learn to construct research instruments that enable them to collect data. They will also learn about the different data collection and analysis tools and techniques. As part of this course, students will take the CITI training and achieve the research readiness they need to succeed in the PhD in IT program.

**Prerequisite(s):** Permission of the instructor. Not open to non-degree graduate students.

**ISQA 9900 ADVANCED RESEARCH IN INFORMATION SYSTEMS (3 credits)**

This course provides a format for exploration of advanced research areas that are of interest to doctoral students in the information systems and/or information technology area. The specific research area will vary from semester to semester, in keeping with research interests of faculty and students. Examples of areas include, but are not limited to, e-business technology, mobile commerce, intelligent agents e-enabled decision support, electronic collaboration, computer-mediated communications, human-computer interaction and information assurance.

**Prerequisite(s):** Admission to PhD program in Information Technology or permission of instructor

**MATH 8016 INTRODUCTION TO THE THEORY OF RECURSIVE FUNCTIONS (3 credits)**

This is a proof-oriented course presenting the foundations of Recursion Theory. We present the definition and properties of the class of primitive recursive functions, study the formal models of computation, and investigate partially computable functions, universal programs. We prove Rice's Theorem, the Recursion Theorem, develop the arithmetic hierarchy, demonstrate Post's theorem. Introduction to the formal theories of computability and complexity is also given. (Cross-listed with CSCI 4010, CSCI 8016, MATH 4010).

**Prerequisite(s):** MATH 2230 or MATH 2030 with a C- or better or CSCI 3660 with a C- or better or instructor's permission.

**MATH 8036 MODERN ALGEBRA (3 credits)**

Algebra is the study of mathematical manipulations that preserve something (like equality - when solving equations). The areas in which Algebra finds application are quite diverse, from Ancient Greek Geometry through to Modern Information Protection and Security (error correcting codes, data compression, and cryptography). This course begins with topics that should be familiar (such as ruler-and-compass constructions, and modular arithmetic) and builds upon this foundation through polynomial rings up to finite fields and basic group theory. (Cross-listed with MATH 4030).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better

**MATH 8050 ALGORITHMIC GRAPH THEORY (3 credits)**

The overall of the goal is to introduce advanced concepts in graph theory, graph modeling, and graph algorithms and how they can be used to solve a wide range of problems in various application domains. The course introduces students to several applied path algorithms, clustering and partitioning techniques, network flow algorithms, and weighted matching algorithms. Other advanced concepts associated with complex networks include node centralities in graphs and community detection approaches. The course will also introduce students to key classes of graphs with a particular focus on the main classes of Perfect Graphs and their applications in scheduling, chip design, mobile computing, and Biomedical Informatics. (Cross-listed with CSCI 8050).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 and MATH 4150 or MATH 8156 or permission of instructor. Not open to non-degree graduate students.

**MATH 8056 LINEAR ALGEBRA (3 credits)**

Linear algebra is extensively utilized in the mathematical modeling of many natural phenomena. Many scientific and engineering disciplines, such as data science, chemical engineering and biology, make extensive use of the theory and techniques commonly present in basic to advanced linear algebra courses. The goal of this course is to help students to grasp a solid theoretical understanding of vectors, vector spaces, inner product spaces, linear transformations, eigenvalues, canonical forms, complex vectors, matrices, and orthogonality. By going through the materials in a mathematically rigorous way, students will develop deeper and more accurate intuitions of the basic concepts in linear algebra. Consequently, the applications of linear algebra will become much more transparent. (Cross-listed with MATH 4050).

**Prerequisite(s):** MATH 2050 with a grade of C- or better; MATH 2030 or MATH 2230 or equivalent with a grade of C- or better; or permission

**MATH 8060 ALGORITHMIC COMBINATORICS (3 credits)**

This course includes classical combinatorial analysis graph theory, trees, network flow, matching theory, external problems, and block designs. (Cross-listed with CSCI 8060).

**Prerequisite(s):** MATH 3100, CSCI 3100, MATH 8105 or CSCI 8105 or instructor's permission.

**MATH 8080 DESIGN AND ANALYSIS OF ALGORITHMS (3 credits)**

The course provides students an understanding of advanced topics in algorithms. Main topics include: growth of functions, asymptotic notation, recurrences, divide and conquer, dynamic programming, greedy algorithms, graph algorithms, and the theory of NP-Completeness. (Cross-listed with CSCI 8080).

**Prerequisite(s):** CSCI 3320 or CSCI 8325 or equivalent. Not open to non-degree graduate students.

**MATH 8105 APPLIED COMBINATORICS (3 credits)**

Basic counting methods, generating functions, recurrence relations, principle of inclusion-exclusion. Polya's formula. Elements of graph theory, trees and searching network algorithms. (Cross-listed with CSCI 3100, CSCI 8105, MATH 3100).

**MATH 8116 ABSTRACT ALGEBRA I (3 credits)**

An introduction to group theory. Various classes of group are studied: symmetric groups, abelian, cyclic, and permutation groups. Basic tools are developed and used: subgroups, normal subgroups, cosets, the Lagrange theorem, group homomorphisms, quotient groups, direct products, and group actions on a set. The course culminates with the Sylow theorems in finite group theory. The theory is illustrated with examples from geometry, linear algebra, number theory, crystallography, and combinatorics. (Cross-listed with MATH 4110).

**Prerequisite(s):** MATH 4050/MATH 8056 with a C- or better or MATH 4560/MATH 8566 with a C- or better or permission of instructor

**MATH 8126 ABSTRACT ALGEBRA II (3 credits)**

An introduction to ring and field theory. Various classes of commutative rings are considered including polynomial rings, and the Gaussian integers. Examples of fields include finite fields and various extensions of the rational numbers. Concepts such as that of an ideal, integral domain, characteristic and extension field are studied. The course culminates with an introduction to Galois theory. Applications include the resolution of two classical problems: the impossibility of angle-trisection and the general insolubility of polynomial equations of degree 5 or higher. (Cross-listed with MATH 4120)

**Prerequisite(s):** MATH 4110/MATH 8116 with a C- or better or permission of instructor

**MATH 8156 GRAPH THEORY & APPLICATIONS (3 credits)**

Introduction to graph theory. Representations of graphs and graph isomorphism. Trees as a special case of graphs. Connectivity, covering, matching and coloring in graphs. Directed graphs and planar graphs. Applications of graph theory in several fields such as networks, social sciences, VLSI, chemistry and parallel processing. (Cross-listed with CSCI 4150, CSCI 8156, MATH 4150).

**Prerequisite(s):** MATH 2030 or permission of instructor.

**MATH 8206 NUMERICAL ANALYSIS (3 credits)**

This course involves solving nonlinear algebraic equations and systems of equations, interpolation and polynomial approximation, numerical differentiation and integration, numerical solutions to ordinary differential equations, analysis of algorithms and errors, and computational efficiency. (Cross-listed with CSCI 4200, CSCI 8206, MATH 4200).

**Prerequisite(s):** MATH 1970 and MATH 2050 and MATH 2350 with a C- or better or permission of instructor.

**MATH 8235 INTRODUCTION TO ANALYSIS (3 credits)**

This course provides a theoretical foundation for the concepts of elementary calculus. Topics include real number system, topology of the real line, limits, functions of one variable, continuity, differentiation. (Cross-listed with MATH 3230).

**Prerequisite(s):** MATH 1960 and MATH 2230 each with a grade of C- or better.



**MATH 8236 MATHEMATICAL ANALYSIS I (3 credits)**

Provides a theoretical foundation for the concepts of classical calculus. Topics include ordered fields, the real and complex number system, basic metric space topology, numerical sequences and series, limits and continuity in metric spaces, monotonic functions, differentiation, (functions of several variables included). (Cross-listed with MATH 4230).

**Prerequisite(s):** MATH 3230/MATH 8235 or equivalent with a grade of C- or better.

**MATH 8246 MATHEMATICAL ANALYSIS II (3 credits)**

Provides a theoretical foundation for the concepts of classical Calculus (vector calculus included). Topics include sequences and series of functions, uniform convergence, power series, Fourier series, multivariable real differential and integral calculus, the Implicit Function Theorem, integration of different forms, and the important formulas, connecting those integrals, due to: Green, Gauss, Riemann, and Ostrogradski. (Cross-listed with MATH 4240).

**Prerequisite(s):** MATH 4230/MATH 8236 with a grade of C- or better.

**MATH 8250 PARTIAL DIFFERENTIAL EQUATIONS (3 credits)**

Partial differential equations (PDEs) are fundamental in the application of mathematics to science and engineering. Topics to be covered will include: Linear and nonlinear first-order equations, classification of second-order linear equations, elliptic, hyperbolic and parabolic equations and boundary value problems, and Green's functions.

**Prerequisite(s):** MATH 1970, MATH 2350, or instructor's permission. MATH 4330/MATH 8336 is recommended, but not required.

**MATH 8255 INTRODUCTION TO NUMERICAL METHODS (3 credits)**

This course emphasizes the implementation of several numerical methods to problems that arise in science and engineering. It involves the application of the computer to solve mathematical problems using the following computational techniques: Taylor Series approximation, numerical differentiation, root-finding methods, interpolation, extrapolation, curve fitting, solution methods for matrix equations, numerical differentiation, numerical integration, and the solution of differential equations. (Cross-listed with MATH 3250).

**Prerequisite(s):** MATH 1960 with a C or better.

**MATH 8276 COMPLEX ANALYSIS (3 credits)**

This course is an introduction to the theory of functions of a complex variable, a fundamental area of mathematics with multiple applications to science and engineering. Topics include the field of complex numbers, complex differentiation, the complex contour integral and Cauchy's integral formula, Taylor expansions and analytic functions, conformal mapping and Riemann's conformal equivalence theorem, residue theory and Laurent series, harmonic functions, and applications. (Cross-listed with MATH 4270).

**Prerequisite(s):** MATH 3230/MATH 8235 with a grade of C- or better or permission of the instructor.

**MATH 8306 DETERMINISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of deterministic operations research models and algorithms. Topics include linear programming, network programming, and integer programming. (Cross-listed with CSCI 4300, CSCI 8306, MATH 4300).

**Prerequisite(s):** MATH 2050 with a C- or better or permission of instructor.

**MATH 8316 PROBABILISTIC OPERATIONS RESEARCH MODELS (3 credits)**

This is a survey course of probabilistic operations, research models and algorithms. Topics include Markov chains, queueing theory, inventory models, forecasting, and simulation. (Cross-listed with CSCI 4310, CSCI 8316, MATH 4310).

**Prerequisite(s):** MATH 2050 and either MATH 4740 or MATH 8746 or STAT 3800 or STAT 8805 all with a C- or better or permission of instructor.

**MATH 8326 COMPUTATIONAL OPERATIONS RESEARCH (3 credits)**

Survey of computational methods used in the solution of operations research problems. Some topics may include scripting to guide optimization software, constraint programming, heuristics and metaheuristics for optimization, basic machine learning algorithms, and simulation. (Cross-listed with MATH 4320, CSCI 4320, CSCI 8326).

**Prerequisite(s):** MATH 3200 or CSCI 1620, and MATH 4300 each with a grade of C- or better or permission of instructor.

**MATH 8336 INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS (3 credits)**

This course introduces the basic methods of PDEs guided by applications in physics and engineering. The main topics to be covered include The Linear First order PDEs, Transport equations, Characteristics, Classification of PDEs, Separation of variables, Heat conduction, vibrating membranes, boundary value problems, Maximum principle, Sturm-Liouville problems, Fourier series, Fourier integrals, Harmonic functions, Legendre polynomials, Distributions, Green's functions. (Cross-listed with MATH 4330).

**Prerequisite(s):** MATH 1970 with a C- or better and MATH 2350 with a C- or better, or permission of instructor; MATH 2050 recommended, not required.

**MATH 8356 ORDINARY DIFFERENTIAL EQUATIONS (3 credits)**

This course covers the theory of initial-, boundary-, and eigenvalue problems, existence theorems, real and complex linear systems of differential equations, and stability theory. There will be a strong emphasis on methods for finding solutions of initial and boundary value problems and analyzing properties of these solutions for various ordinary differential equations. (Cross-listed with MATH 4350).

**Prerequisite(s):** MATH 1970 with a C- or better, MATH 2050 with a C- or better, and MATH 2350 with a C-, or better or instructor's permission.

**MATH 8400 DYNAMICAL SYSTEMS AND CHAOS (3 credits)**

Review of difference equations and differential equations, stability theory, periodic orbits, bifurcations, Lyapunov exponents, fractals, chaotic orbits, and chaotic attractors.

**Prerequisite(s):** Permission from Instructor (If you have a background that covers introduction to analysis, differential equations, linear algebra, and you are somewhat familiar with computer codes, it is easy to obtain permission.)

**MATH 8406 THE FINITE ELEMENT METHOD (3 credits)**

Introduction to finite elements methods for solving ordinary and partial differential equations. Theoretical foundations of finite element methods for boundary value problems, approximation by piecewise polynomial functions, variation formulation of partial differential equations, basic error estimates. The Rayleigh-Ritz-Galerkin method, convergence of approximations, time-dependent problems, error analysis, discretization and computer implementation, applications to problems in elasticity, heat transfer, and fluid mechanics. (Cross-listed with MATH 4400).

**Prerequisite(s):** MATH 1970, MATH 2050 and MATH 2350 all with a C- or better or instructor permission. MATH 3300/MATH 8305 and MATH 4330/MATH 8336 recommended. Students should be able to use a programming language (ie MATLAB) to complete computational assignments

**MATH 8410 BOOLEAN NETWORKS (3 credits)**

This course is focused on introduction to discrete dynamical networks, in particular logical networks, and their applications.

**Prerequisite(s):** MATH 1960 (Calculus II), MATH 2230 (proof writing skills), MATH 4740 or equivalent (basic probability theory), basic computer skills; or permission of the instructor.

**MATH 8430 LINEAR PROGRAMMING (3 credits)**

This course includes a complete development of theoretical and computational aspects of linear programming. Basic theoretical foundations covered include polyhedra, convexity, linear inequalities and duality. Advanced topics such as decomposition and column generation are covered. Both simplex methods and interior point methods are included.

**Prerequisite(s):** MATH 4300/MATH 8306

**MATH 8440 NETWORK PROGRAMMING (3 credits)**

A presentation of network flow models and optimization algorithms. Topics include pure, generalized, integer, and constrained network problems, plus special cases of each, including transportation, assignment, shortest-path, transshipment, and multicommodity.

**Prerequisite(s):** MATH 4300/MATH 8306

**MATH 8456 INTRODUCTION TO MACHINE LEARNING AND DATA MINING (3 credits)**

This is an introduction to machine learning and data mining which covers the following topics with an emphasis on mathematical and statistical analysis: linear and nonlinear regression models, model selection and regularization methods, resampling methods, classification models, tree-based models, and unsupervised learning topics. If time allows, text mining and deep learning will also be introduced in the course. Statistical software will be used. (Cross-listed with MATH 4450, STAT 4450, STAT 8456)

**Prerequisite(s):** MATH 4740/8746 with a C- or better or STAT 3800/8805 with a C- or better or permission of instructor.

**MATH 8460 INTEGER PROGRAMMING (3 credits)**

Advanced study in mathematical programming with integer or mixed integer variables. Topics include integer programming, modeling, applications of integer programming, and exploration of solution algorithms based on linear programming and heuristic methods such as tabu search, simulated annealing, and genetic algorithms.

**Prerequisite(s):** MATH 4300/CSCI 4300/MATH 8306/CSCI 8306. Not open to non-degree graduate students.

**MATH 8480 MULTI-AGENT SYSTEMS AND GAME THEORY (3 credits)**

This course covers advanced topics in the area of coordination of distributed agent-based systems with a focus on computational aspects of game theory. The main topics covered in this course include distributed constraint satisfaction, distributed constraint optimization, and competitive and cooperative game theory. (Cross-listed with CSCI 8480).

**Prerequisite(s):** CSCI 4450 or CSCI 8456. Suggested background courses: CSCI 4480 or CSCI 8486; CSCI 8080. Not open to non-degree graduate students.

**MATH 8500 NUMERICAL LINEAR ALGEBRA (3 credits)**

Topics covered in this course include error propagation, solutions of nonlinear equations, solutions of linear and nonlinear systems by various schemes, matrix norms and conditioning, and computation of eigenvalues and eigenvectors. (Cross-listed with CSCI 8500).

**Prerequisite(s):** MATH 1960 and MATH 2050, or permission of instructor. Familiarity with computer programming is assumed.

**MATH 8510 NUMERICAL DIFFERENTIAL EQUATIONS (3 credits)**

Topics covered in this course include interpolation and approximations, numerical differentiation, numerical integration, and numerical solutions of ordinary and partial differential equations. (Cross-listed with CSCI 8510).

**Prerequisite(s):** MATH 1970, MATH 2350, or permission of instructor. Familiarity with computer programming is assumed.

**MATH 8520 ADVANCED TOPICS IN OPERATIONS RESEARCH (3 credits)**

Advanced treatment of a specific topic in the area of operations research not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with CSCI 8520).

**Prerequisite(s):** MATH 4300 or MATH 8306 or CSCI 4300 or CSCI 8306 or permission of the instructor.

**MATH 8566 NUMBER THEORY & CRYPTOGRAPHY (3 credits)**

An overview of one of the many beautiful areas of mathematics and its modern application to secure communication. The course is ideal for any student who wants a taste of mathematics outside of, or in addition to, the calculus sequence. Topics to be covered include: prime numbers, congruences, perfect numbers, primitive roots, quadratic reciprocity, sums of squares, and Diophantine equations. Applications include error-correcting codes, symmetric and public key cryptography, secret sharing, and zero knowledge proofs. (Cross-listed with CSCI 4560, CSCI 8566, MATH 4560).

**Prerequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better or CSCI 2030 with a C- or better or permission of instructor

**MATH 8616 INTRODUCTION TO TOPOLOGY (3 credits)**

This is a proof-oriented course presenting the foundations of topology. Metric spaces and general topological spaces are introduced. The course explores the properties of connectedness, compactness and completeness, and operations of Tychonoff product and hyperspace. (Cross-listed with MATH 4610).

**Prerequisite(s):** MATH 3230/8235 with a C- or better or permission of instructor.

**MATH 8620 GENERAL TOPOLOGY (3 credits)**

General topology has roots in geometry and analysis through the study of spaces, dimensions, and transformations. Its development was influenced by the parallel development of (axiomatic) set theory. This course introduces topological spaces from the point of view of separation axioms, countability axioms, compactifications, Baire property, and other completeness properties. Basic concepts of Descriptive Set Theory are also introduced.

**Prerequisite(s):** MATH 4610/8616 or permission of instructor.

**MATH 8626 ITERATED FUNCTION SYSTEMS AND FRACTALS (3 credits)**

This is a proof-oriented course presenting the foundations of fractal geometry. It introduces students to the beauty, magic, and applications of fractals and iterated function systems, with emphasis on the mathematics behind it all. Topics range from contractions on hyperspaces and their fixed points to fractal dimensions to Julia and Mandelbrot sets. (Cross-listed with MATH 4620).

**Prerequisite(s):** MATH 8616 with a C or better or permission of instructor.

**MATH 8645 MODERN GEOMETRY (3 credits)**

This course will study the modern foundations of Euclidean and Non-Euclidean Geometry. Included will be a study of the principles of axiomatic systems. Euclidean Geometry will be investigated using Hilbert's axioms for Euclidean geometry (or another equivalent Euclidean geometry axiom set). Hyperbolic geometry will be encountered through the models of Klein and Poincare. Neutral geometry with Lambert and Saccheri quadrilaterals will be studied. Finite geometries and projective geometries will also be explored. (Cross-listed with MATH 3640).

**Prerequisite(s):** MATH 2230 with a grade of C- or better.

**MATH 8650 INTRODUCTION TO PROBABILITY MODELS (3 credits)**

This is an introduction to probability modeling including Poisson Processes, Markov chains, birth-death processes, queueing models and renewal theory. Applications will be an important part of the course.

**Prerequisite(s):** MATH 4740/MATH 8746 or STAT 3800/STAT 8805 or permission of instructor.

**MATH 8666 AUTOMATA, COMPUTABILITY, AND FORMAL LANGUAGES (3 credits)**

This course presents a sampling of several important areas of theoretical computer science. Definition of formal models of computation and important properties of such models, including finite automata and Turing machines. Definition and important properties of formal grammars and their languages. Introduction to the formal theories of computability and complexity. (Cross-listed with CSCI 4660, CSCI 8666, MATH 4660).

**Prerequisite(s):** MATH 2030. Recommended: CSCI 3320/CSCI 8325.

**MATH 8670 TOPICS IN PROBABILITY AND STATISTICS (3 credits)**

Advanced treatment of a specific topic in the area of probability and/or statistics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with STAT 8670).

**Prerequisite(s):** MATH 4750/MATH 8756 or STAT 3800/STAT 8805 or permission from instructor

**MATH 8720 RELIABILITY THEORY (3 credits)**

This course covers the probabilistic and statistical aspects of reliability theory. Reliability theory is concerned with the probability that a component or system is successfully working over a given time period or at a specific time instance. (Cross-listed with STAT 8720).

**MATH 8746 INTRODUCTION TO PROBABILITY AND STATISTICS I (3 credits)**

A mathematical introduction to probability theory including the properties of probability; probability distributions; expected values and moments; specific discrete and continuous distributions; and transformations of random variables. (Cross-listed with MATH 4740).

**Prerequisite(s):** MATH 1970 and either MATH 2230 or MATH 2030 all with a grade of C- or better or permission of instructor.

**MATH 8756 INTRODUCTION TO PROBABILITY AND STATISTICS II (3 credits)**

Theory and methods of statistical inference including sampling distributions, estimators, estimation, and statistical hypotheses. (Cross-listed with MATH 4750).

**Prerequisite(s):** MATH 4740/MATH 8746 with a grade of C- or better.

**MATH 8766 TOPICS IN APPLIED MATHEMATICS (3 credits)**

Selection of such topics such as dynamical systems and chaos, Boolean networks, modeling of discrete or continuous systems, matrix theory, difference equations, information theory, discrete events simulation and other approved by Upper Curriculum Committee. (Cross-listed with MATH 4760).

**Prerequisite(s):** MATH 3100/CSCI 3100 with a grade of C- or better, or permission of instructor.

**MATH 8855 HISTORY OF MATHEMATICS (3 credits)**

An overview of the history of mathematics and famous mathematicians via studying and solving famous mathematical problems, exploring famous mathematical theorems, and studying the biographies of famous mathematicians. (Cross-listed with MATH 3850).

**Prerequisite(s):** MATH 1950 with a grade of C- or higher and one of either MATH 2230 or MATH 2000 with a grade of C- or higher.

**MATH 8956 TOPICS IN THEORETICAL MATHEMATICS (3 credits)**

This course introduces students to a specialized subject matter in the areas of theoretical mathematics not covered in existing courses. The course may be repeated for different topics up to a maximum of six credit hours. The specific topics will vary, depending upon when the course is offered. One example of a course is Axiomatic Set Theory. (Cross-listed with MATH 4950).

**Prerequisite(s):** Permission of instructor.

**MATH 8960 MASTER'S PROJECT (1-6 credits)**

An applied project, designed and executed under the supervision of both a faculty and industry advisor. In the project the student will apply their mathematical and/or statistical skills to an applied problem. The student will present their results via a written report and oral presentation. (Cross-listed with STAT 8960).

**Prerequisite(s):** Permission of faculty advisor and graduate program chair. Not open to non-degree graduate students.

**MATH 8970 INDEPENDENT GRADUATE STUDIES (1-3 credits)**

Under this number a graduate student may pursue studies in an area that is not normally available to him/her in a formal course. The topics studied will be a graduate area in mathematics to be determined by the instructor.

**Prerequisite(s):** Permission of instructor and graduate classification.

**MATH 8980 GRADUATE SEMINAR (3 credits)**

A graduate seminar in mathematics offering coverage of advanced areas of mathematics. Topics to be covered by the course will vary in different semesters.

**Prerequisite(s):** Permission of the Instructor.

**MATH 8990 THESIS (1-6 credits)**

An independent research project, written under the supervision of a graduate adviser in the department of mathematics. Approval of the topic and the completed project by thesis committee is required.

**Prerequisite(s):** Approval of the topic and the completed project by thesis committee is required.

**MATH 9110 ADVANCED TOPICS IN APPLIED MATHEMATICS (3 credits)**

Advanced treatment of a specific topic in the area of applied mathematics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ.

**Prerequisite(s):** Permission of instructor.

**MATH 9230 THEORY OF FUNCTION OF REAL VARIABLES (3 credits)**

A theoretical foundation for the concepts of measure theory and integration on a measure space as developed by Henry Leon Lebesgue (followed by others) starting the first decade of the 20th century including a comparison with Riemann's classical construction of integration theory known from classical calculus. Topics include: Real number system, convergence, continuity, bounded variation, differentiation, Lebesgue-Stieltjes integration, abstract measure theory, and the  $L_p$  spaces.

**Prerequisite(s):** MATH 4230/MATH 8236 or permission of the instructor

**STAT 8005 STATISTICAL METHODS I (3 credits)**

An introduction to descriptive statistics, measures of central value and dispersion, probability and distributions, population and sample, simple linear regression, statistical inference: point estimation, confidence intervals, hypotheses testing, two population comparison, goodness-of-fit tests, analysis of variance. Statistical software like Minitab or Excel will be utilized in the course. (Cross-listed with STAT 3000).

**Prerequisite(s):** MATH 1220 or MATH 1300 or MATH 1320 or equivalent with a grade of C- or better, or permission of instructor

**STAT 8416 INTRODUCTION TO DATA SCIENCE (3 credits)**

Topics covered in this course include Data Technology, Methods of gathering and cleaning structured or unstructured data, Exploratory data analysis & Dynamic and interactive data visualization, Modeling data for prediction, forecasting or classification. (Cross-listed with STAT 4410).

**Prerequisite(s):** MATH 4740 with a C- or better or concurrent; or STAT 3800 with a C- or better or concurrent; or permission of instructor. Students should be comfortable with computer programming & have knowledge of data structures & preliminary statistical methods.

**STAT 8426 EXPLORATORY DATA VISUALIZATION AND QUANTIFICATION (3 credits)**

Topics covered in this course include Exploratory Data Visualization for categorical/qualitative single/multivariate data, Grammar of Graphics, Organizing Data for Visualization, Methods of Displaying Data that include dynamic and interactive visualization, Visual Diagnostics of Statistical Models and Visual Statistical Inference. Students planning to enroll in this course should be comfortable with computer programming and have knowledge of data structures and preliminary statistical methods. (Cross-listed with STAT 4420)

**Prerequisite(s):** STAT 3800 or STAT 8805 or MATH 4740 or MATH 8746 with a grade of C- or better or another introductory probability/statistics course with a grade of C- or better, and MATH 3200 or CSCI 1620 with a grade of C- or better, or permission of instructor.

**STAT 8436 LINEAR MODELS (3 credits)**

This is an introduction to linear statistical models which will include: simple linear regression models, multiple linear regression models, ANOVA models including one way ANOVA, randomized block design, and other designs. Also, logistic regression models, Poisson regression models, bootstrapping/resampling models, survival analysis. Some necessary linear algebra and mathematical statistics ideas will be covered in the course also. If time allows, some mixed models and/or survival models. Much use of computer software will be made. (Cross-listed with STAT 4430)

**Prerequisite(s):** MATH 4750 or MATH 8756 w/ a grade of C- or better or STAT 3800 or STAT 8805 w/ a C- or better or instructor permission based on students' having taken a basic statistics course w/ a grade of C- or better & having at least a basic knowledge of calculus.

**STAT 8446 TIME SERIES ANALYSIS (3 credits)**

The objective of this course is to learn and apply statistical methods for the analysis of data that have been observed over time. Topics covered include: Models for Stationary and Non-Stationary Time Series, Model Specification, Parameter Estimation, Model Diagnostics, Forecasting, Seasonal Models, Time Series Regression, and Spectral Analysis. Statistical software will be used. (Cross-listed with STAT 4440)

**Prerequisite(s):** MATH 4750 or MATH 8756 w/ a grade of C- or better or STAT 3800 or STAT 8805 w/ a C- or better or another introductory probability/statistics course w/ a C- or better, or permission of instructor.

**STAT 8456 INTRODUCTION TO MACHINE LEARNING AND DATA MINING (3 credits)**

This is an introduction to machine learning and data mining which covers the following topics with an emphasis on mathematical and statistical analysis: linear and nonlinear regression models, model selection and regularization methods, resampling methods, classification models, tree-based models, and unsupervised learning topics. If time allows, text mining and deep learning will also be introduced in the course. Statistical software will be used. (Cross-listed with MATH 4450, MATH 8456, STAT 4450)

**Prerequisite(s):** MATH 4740/8746 with a C- or better or STAT 3800/8805 with a C- or better or permission of instructor.

**STAT 8670 TOPICS IN PROBABILITY AND STATISTICS (3 credits)**

Advanced treatment of a specific topic in the area of probability and/or statistics not available in the regular curriculum. Topics, developed by individual faculty members, will reflect their special interests and expertise. The course may be repeated for credit as topics differ. (Cross-listed with MATH 8670).

**Prerequisite(s):** MATH 4750/MATH 8756 or STAT 3800/STAT 8805 or permission from instructor

**STAT 8700 BAYESIAN STATISTICS (3 credits)**

The objective of this course is to introduce the Bayesian approach to statistical inference. Topics covered include: Review of probability, Bayes theorem, and Likelihood; The Bayesian methodology, prior and posterior distributions; Choices of prior distribution, conjugate and Jeffreys priors; Credible intervals and inference; Bayesian computation - Markov Chain Monte Carlo and the Gibbs Sampler; Hierarchical models; Regression models.

**Prerequisite(s):** MATH 8756 or equivalent or permission of instructor.

**STAT 8710 DESIGN AND ANALYSIS OF EXPERIMENTS (3 credits)**

Introduction to design and analysis of controlled experiments. The goal of experimental design is to be able to construct an experiment to identify which factors most impact the response and do so in an efficient manner. Statistical software will be used. Types of designs studied include: Randomized Block Designs, Latin Square Designs, Incomplete Block Designs, Factorial Designs, and Nested Designs.

**Prerequisite(s):** MATH 4750/8756 or permission of instructor.

**STAT 8720 RELIABILITY THEORY (3 credits)**

This course covers the probabilistic and statistical aspects of reliability theory. Reliability theory is concerned with the probability that a component or system is successfully working over a given time period or at a specific time instance. (Cross-listed with MATH 8720).

**Prerequisite(s):** Either MATH 4740 or STAT 3800 or permission of the instructor. Some basics of mathematical analysis are helpful when discussing limit theorems, but not required.

**STAT 8730 ADVANCED STATISTICAL MACHINE LEARNING (3 credits)**

This course will introduce machine learning models from a statistical perspective. Comparing to the introductory machine learning course, this course will focus more on (1) probability and statistical theory for machine learning methods; (2) relationship between machine learning and high-dimensional multivariate statistical analysis; (3) evolution and frontier of machine learning methods; (4) algorithm development for research purpose. Programming software will be used.

**Prerequisite(s):** MATH 4750/8756 with a C or better or permission of instructor.

**STAT 8805 APPLIED ENGINEERING PROBABILITY AND STATISTICS (3 credits)**

An introduction to the application of probability and statistics to engineering problems. Topics include: probability and probability distributions, mathematical expectation, distribution of random variables, binomial, Poisson, hypergeometric, gamma, normal, and t-distributions, Central Limit Theorem, confidence intervals, hypothesis testing. If time allows, some linear regression and contingency tables. Credit for both MATH 4740 and STAT 3800 will not be given. (Cross-listed with STAT 3800)

**Prerequisite(s):** MATH 1970

**STAT 8950 DATA SCIENCE CAPSTONE PROJECT (3 credits)**

The Data Science Capstone Project completes the Data Science Master (MS) student's graduate experience. Students will work on individual tasks and team-based activities on a real-world project. This course intends to provide experience in the industrial practice of real-world data science pipeline-building projects. Furthermore, this course allows MS students to integrate and improve the technical skills they learned throughout their graduate education and will enable them to enhance professional skills such as communication and teamwork. (Cross-listed with DSCI 8950).

**Prerequisite(s):** Complete all core courses of the MS Data Science program (STAT 8416, STAT 8426, ECON 8320, ECON 8310/BSAD 8080, ISQA 8206, ITIN 8300/ISQA 8060) and Permission from the Instructor. Not open to non-degree graduate students.

**STAT 8960 MASTER'S PROJECT (1-6 credits)**

An applied project, designed and executed under the supervision of both a faculty and industry advisor. In the project the student will apply their mathematical and/or statistical skills to an applied problem. The student will present their results via a written report and oral presentation. (Cross-listed with MATH 8960).

**Prerequisite(s):** Permission of faculty advisor and graduate program chair. Not open to non-degree graduate students.