

# DATA SCIENCE, MS

## College of Arts and Sciences, Business Administration, and Information Technology

### 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

### Application Deadlines (Spring 2021, and Fall 2021)

- Spring: December 15
- Fall: July 1

### Program Specific Requirements

- Minimum GPA of at least 3.0 in undergraduate degree.
- 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, must meet the minimum language proficiency score requirement in order to be considered for admission.
  - The minimum scores for applicants are: 550 for the written TOEFL, 80 for the internet-based TOEFL, 6.5 on the IELTS or 53 for the PTE.
- Three (3) letters of recommendation.
- Resume: An up-to-date resume with details about all relevant IT experience and skills.
- Interview: A personal, telephone or Skype interview is encouraged, but is optional.
- **Applicants with International Transcripts:** Any applicant to this program who has completed undergraduate or graduate coursework at an international higher education institution outside of the United States may submit transcripts and degree certificates (with an English translation) in lieu of a course-by-course transcript evaluation from World Education Services (<https://www.wes.org/>) (WES), Educational Credential Evaluators (<https://www.ece.org/>) (ECE), or Educational Perspectives (<https://www.edperspective.org/>). This graduate program will conduct an in-house credential evaluation of your transcript(s).
  - UNO reserves the right to require a course-by-course evaluation from WES, ECE, or Educational Perspectives if the program is unable

to complete an evaluation or should there be any questions or concerns about the documentation that is received. You will be notified by the individual program if an external course-by-course evaluation is required.

- \*Note: If you are admitted, official transcripts and degree certificates (with an English translation)/official course-by-course transcript evaluation, and any applicable official exam scores are required.

## 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	
BSAD 8080	BUSINESS FORECASTING	
ISQA 8206	INFORMATION AND DATA QUALITY MANAGEMENT	
ITIN 8300 or ISQA 8060	RESEARCH FOUNDATIONS RESEARCH IN MIS	
<b>Concentration</b>		<b>12</b>
Select one of the five concentration areas.		
<b>Exit Requirement</b>		<b>6</b>
Total Credits		36

## Exit Requirements

- Project 3 Credits and 3 hours of additional electives is required for this option.
- 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.

## Business Concentration

Code	Title	Credits
<b>Select 12 hours from the following:</b>		<b>12</b>
BSAD 8910	SPECIAL TOPICS IN BUSINESS	
BSAD 8426	BUSINESS DEMOGRAPHICS	
BSAD 8376	SUPPLY CHAIN ANALYTICS	
ECON 8330	DATA ANALYSIS FROM SCRATCH	
ECON 8300	ECONOMETRICS	
ECON 8316	BUSINESS INTELLIGENCE AND REPORTING	
Total Credits		12

## Information Technology Concentration

Code	Title	Credits
<b>Select 12 hours from the following:</b>		<b>12</b>
ISQA 8156	ADVANCED STATISTICAL METHODS FOR IS&T	
ISQA 8340	APPLIED REGRESSION ANALYSIS	
ISQA 8016	BUSINESS INTELLIGENCE	
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	
CSCI 8476	PATTERN RECOGNITION	
ISQA 9120	APPLIED EXPERIMENTAL DESIGN AND ANALYSIS	
ISQA 9130	APPLIED MULTIVARIATE ANALYSIS	
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 8750	STORYTELLING WITH DATA	
Total Credits		12

## 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 8710	DESIGN AND ANALYSIS OF EXPERIMENTS	
MATH 8306	DETERMINISTIC OPERATIONS RESEARCH MODELS	
MATH 8316	PROBABILISTIC OPERATIONS RESEARCH MODELS	
MATH 8650	INTRODUCTION TO PROBABILITY MODELS	
MATH 8670	TOPICS IN PROBABILITY AND STATISTICS	
MATH 8440	NETWORK PROGRAMMING	
MATH 8460	INTEGER PROGRAMMING	
Total Credits		12

## Data Science for Health Sciences

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	GENETIC SEQUENCE ANALYSIS	
CSCI 8156	GRAPH THEORY & APPLICATIONS	
STAT 8456	INTRODUCTION TO MACHINE LEARNING AND DATA MINING	
Total Credits		12

## 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>
Total Credits		12

### 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)/Corequisite(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)/Corequisite(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)/Corequisite(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 8080 SEMINAR IN BIOMEDICAL INFORMATICS (1-3 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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** Class standing of senior or above.

**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)/Corequisite(s):** Proficiency in programming and knowledge of calculus are required. Familiarity with concepts from biology is beneficial 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)/Corequisite(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 learn recent developments in Bioinformatics, particularly, from the algorithmic standpoint. The course will present basic algorithmic concepts in Bioinformatics and show how they are connected to molecular biology and biotechnology. Standard topics in the field such as restriction mapping, motif finding, sequence comparison, and database search will be covered. The course will also address problems related to Bioinformatics like next generation sequencing, DNA arrays, genome rearrangements and biological networks. (Cross-listed with BIOI 4860).

**Prerequisite(s)/Corequisite(s):** CSCI 3320 and BIOL 1450; Or permission of instructor.

**BMI 8896 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.

**Prerequisite(s)/Corequisite(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)/Corequisite(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)/Corequisite(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 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)/Corequisite(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)/Corequisite(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 (1-3 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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 8010 LEGAL, SOCIAL AND ETHICAL ENVIRONMENT (3 credits)**

Focus upon law and ethics. Business law, legal processes, and regulation will be the subject matter focus. Business ethics will be a recurring focus of analysis. Analysis of the social environment will include public policy. Both subject matter and analysis will be integrated to build the student's critical thinking skills.

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

**BSAD 8020 ENVIRONMENTAL ECONOMICS AND MANAGEMENT (3 credits)**

This course covers topics related to environmental economics and policy, with an emphasis on comparative policy analysis and business strategies towards the environment. (Cross-listed with ECON 8020)

**Prerequisite(s)/Corequisite(s):** Principles of Microeconomics (ECON 2200) and Principles of Macroeconomics (ECON 2220), or Analytical Foundations of Economics (BSAD 8180), or permission of the instructor. Not open to non-degree graduate 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. (Cross-listed with ECON8296.)

**Prerequisite(s)/Corequisite(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)/Corequisite(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)/Corequisite(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 8050 BUSINESS CONDITIONS ANALYSIS (3 credits)**

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

**Prerequisite(s)/Corequisite(s):** ECON 2200 or BSAD 8180. Not open to nondegree 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)/Corequisite(s):** Admission to the MBA program. Not open to non-degree graduate students.

**BSAD 8070 EXECUTIVE COMMUNICATION (1 credit)**

This course emphasizes both strategic and practical approaches to business communication from an executive perspective and provides students with tools to improve their business communication skills. This course will focus on composing effective executive/business documents business reports, and briefings.

**Prerequisite(s)/Corequisite(s):** Enrollment in Executive MBA Program. 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. We will cover traditional Econometric forecasting methods in the first half of the class. In the second half of the course, we will focus on models in predictive analytics and machine learning, since these models are quickly becoming critical tools for forecasters in many settings. The course will include lecture and lab time, and labs will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with ECON 8310).

**Prerequisite(s)/Corequisite(s):** ECON 8320 (or equivalent programming experience) AND ECON 8300 (or equivalent multivariate regression analysis coursework) 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)/Corequisite(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 PRINCIPLES OF COLLABORATION (3 credits)**

Students will work with techniques for team leadership, interpersonal collaboration, consensus-building, creative problem solving, negotiation, facilitation, group process design, collaborative workspace design, and collaboration engineering. Students will gain hands-on experience with collaboration technologies. (Cross-listed with MGMT 4090, ITIN 4090)

**Prerequisite(s)/Corequisite(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. (Cross-listed with ECON 8210).

**Prerequisite(s)/Corequisite(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)/Corequisite(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 human resource management concepts and practices. The course is designed to educate future managers and leaders on the importance of utilizing effective human resource methods that comply with federal laws and provide the organization with high-quality talent that provides a competitive advantage. (Cross-listed with MGMT 4030).

**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 benefit programs. The course is designed to enable future managers and human resource professionals to utilize effective strategies for managing the single largest controllable expense for organizations; employee pay and benefits. (Cross-listed with MGMT 4010).

**Prerequisite(s)/Corequisite(s):** BSAD 8136 or permission of instructor

**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)/Corequisite(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)/Corequisite(s):** BSAD 8136 or permission of instructor.

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

This course is a comprehensive review of issues and techniques related to the acquisition of high-quality human resources for optimal organizational effectiveness. The course is designed to enable future managers and human resource professionals to utilize effective strategies for recruiting, selecting, placing, and integrating new employees into the organization's workforce. (Cross-listed with MGMT 4110).

**Prerequisite(s)/Corequisite(s):** BSAD 8136 or permission of instructor.

**BSAD 8180 ANALYTICAL FOUNDATIONS OF ECONOMICS (3 credits)**

To familiarize students with the basic economic theory and policy analysis (principles level) required to analyze economic problems and to understand and evaluate recommendations designed to solve those problems. This is a course for students and professionals seeking a degree of Master of Business Administration with little or no formal background in economics.

**Prerequisite(s)/Corequisite(s):** Graduate. This course cannot be used in a plan of study for any graduate program at UNO. 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** 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)/Corequisite(s):** Senior or graduate student standing and permission of the instructor. Not open to non-degree graduate students.

**BSAD 8230 CHANGE MANAGEMENT (2 credits)**

This course provides a theoretical as well as pragmatic approach to change management for executive and senior level leaders in all types of organizations. Focus is given to organizational structure, managing culture, and critical components of senior level management effectiveness in leading change.

**Prerequisite(s)/Corequisite(s):** Enrollment in the Executive MBA program. Not open to non-degree graduate students.

**BSAD 8240 EXECUTIVE LEADERSHIP DEVELOPMENT (2 credits)**

This course aims to enhance the leadership effectiveness of students by developing executive competencies in problem solving, collaborative behaviors, teamwork, and conflict resolution. Students will gain crucial experience in using effective leadership tools to become leaders who act with a deeper understanding of themselves, their organizations, and their communities, and contribute positively to the growth of each.

**Prerequisite(s)/Corequisite(s):** Enrollment in UNO's Executive MBA program. 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)/Corequisite(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 ACCOUNTING THEORY & PRACTICE (2 credits)**

This course is designed to enhance students' understanding of 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)/Corequisite(s):** Enrollment in UNO's Executive MBA program. Not open to non-degree graduate students.

**BSAD 8270 CONTEMPORARY ECONOMICS FOR BUSINESS MANAGEMENT (3 credits)**

Only students who have been admitted to the Executive MBA program may take this course. This course will familiarize students and professionals with the microeconomic and the macroeconomic principles relevant to: (a) individual and business firm decision-making; (b) the domestic and international environment in which economic decisions are made; (c) the evaluation of policies designed to solve economic problems.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8280 STEWARDSHIP OF THE FIRM'S RESOURCES: HUMAN RESOURCE MANAGEMENT (2 credits)**

This course provides a comprehensive review of effective human resource theory and practice with an emphasis on managerial influence on attracting, retaining, developing, and rewarding employees.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8290 MARKETING MANAGEMENT (3 credits)**

Only students who have been admitted to the Executive MBA program may take this course. As this course is the initial course of marketing in the degree program, it establishes the basic foundation of the marketing discipline as well as provides the basis for further exploration and study of the discipline of marketing. The foundation of principles, concepts and nomenclature of marketing are the primary structure of the course. It is intended to provide a comprehensive knowledge of marketing. Further, the course challenges the students to explore further the applications of the foundation knowledge of the course.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

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

A study of theories and guidelines for enhancing organizational effectiveness by matching an organization's structure to its environment, strategy, technology and size.

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

**BSAD 8320 SEMINAR IN HUMAN RESOURCE MANAGEMENT (3 credits)**

Extensive treatment of the relevant developing theories and coverage of certain new methods, techniques and procedures that relate to personnel administration and human resource management. Efforts are made to select and present material to illustrate the practical, applied aspects of resource management and personnel administration, as related to human problems in organizations.

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

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

The student will be exposed to the current research findings in sales management and to business cases where the theories and concepts will be applied. The cases will come from either academic sources such as the Harvard Business School or from business owners and managers from the local business community. (Cross-listed with MKT 4320.)

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

**BSAD 8330 STRATEGIC COLLABORATION: LEADING HIGH IMPACT TEAMS (1 credit)**

This course is designed to enhance students' understanding of collaboration principles, practices and processes. In this interactive course, students will learn how to utilize collaboration tools and techniques and creative problem solving methods to enhance strategic decision making. Other concepts that will be introduced include building and assessing high-performing teams, managing and leading teams, identifying and resolving team dysfunctions, and team decision making approaches. Ultimately, students will learn how to be more influential and improve interactions so people and organizations can work together more efficiently.

**Prerequisite(s)/Corequisite(s):** Enrollment in Executive MBA Program. Not open to non-degree graduate students.

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

This course will focus on the planning and execution of complex projects within an organization. Students will learn how to conduct stakeholder analysis, plan the scope of a project, develop a project budget, lead a project team, and define the steps necessary to bring a complex project to a successful conclusion. Students will recognize how the strategy, structure, and culture of an organization can be used to identify and prioritize complex projects. (Cross-listed with MGMT 4330, SCMT 4330)

**Prerequisite(s)/Corequisite(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. Typically, travel is conducted during Spring Break.

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

**BSAD 8350 SEMINAR IN MANAGEMENT (3 credits)**

A student participation course emphasizing current issues and problems in the areas of management theory and operation.

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

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

This course will focus 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 focused on 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)/Corequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree graduate students.

**BSAD 8360 FINANCIAL MANAGEMENT FOR EXECUTIVES (3 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 and others..

**Prerequisite(s)/Corequisite(s):** Enrollment in the Executive MBA program. Not open to non-degree graduate students.

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

The focus of this course is understanding the Internet as a marketing tool. The content includes discussion of how the Internet is used by businesses for designing products, pricing, promotions, and distributions thereof. The larger impact of the Internet on businesses and future trends also is discussed. (Cross-listed with MKT 4360.)

**Prerequisite(s)/Corequisite(s):** BSAD 8400 with a grade of 'B' or above. Not open to nondegree students.

**BSAD 8370 BUSINESS LAW AND ETHICS (2 credits)**

Only students who have been admitted to the Executive MBA program may take this course. A comprehensive examination of the existing structure and mechanisms used to resolve disputes in the United States, which allows the student to understand the strengths and weaknesses of this system. It will specifically examine the body of substantive law that affects management, including court decisions, statutes (federal and state), traditional ethical theories as they relate to the law, and international problems that exist in the legal environment.

**Prerequisite(s)/Corequisite(s):** Enrollment in Executive MBA Program. Not open to non-degree graduate students.

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

This course focuses on the integration of 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)/Corequisite(s):** Admission to Graduate College, MBA Program or by permission of the instructor. Not open to non-degree students.

**BSAD 8380 STRATEGIC OPERATIONS MANAGEMENT (2 credits)**

Students will learn how effective decision-making skills can be used to create a long-term competitive advantage for an organization through operational excellence. Key concepts in this course will include operations management, quality management, and data analytics. Specific topics will include process improvement, quality assurance, supply chain management, project management, and performance assessment.

**Prerequisite(s)/Corequisite(s):** Enrollment in UNO's Executive MBA program. Not open to non-degree graduate students.

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

**BSAD 8390 CONTEMPORARY ACCOUNTING SYSTEMS: MANAGEMENT ACCOUNTING (3 credits)**

Only students who have been admitted to the Executive MBA program may take this course. The course is designed to give students an in-depth understanding of how accounting information is used by management decision-makers. The accounting information system generates information managers use for pricing, budgeting, performance appraisal, purchasing production, capital acquisition, etc. The course focuses on both theoretical and practical dimensions of the topic.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree 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)/Corequisite(s):** Completion of MBA foundation courses and BSAD 8060 (prior to or concurrent); or admission to MAcc program. Not open to nondegree 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)/Corequisite(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 development of a demographic perspective to assist in understanding the business environment and business policy. How population change impacts upon 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)/Corequisite(s):** Graduate standing. 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)/Corequisite(s):** BSAD 8420 or permission of instructor. Not open to nondegree students.

**BSAD 8440 DECISION ANALYTICS (2 credits)**

Students will learn to use statistical and decision making tools to interpret data to solve practical management problems and gain desired results. Areas of focus will include market research, decision analysis, data analytics, and business forecasting.

**Prerequisite(s)/Corequisite(s):** Enrollment in Executive MBA Program. 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)/Corequisite(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. The ability to negotiate successfully rests on a combination of analytical and interpersonal skills. In this course we will develop a set of conceptual frameworks that should help students better analyze negotiations in general and prepare more effectively for future negotiations in which they may be involved. This course is designed to help students better understand the theories, processes, and practices of negotiation, as well as conflict resolution and relationship management so that students can be more effective negotiators in a wide variety of situations. (Cross-listed with MGMT 4450, SCMT 4450).

**BSAD 8460 MANAGEMENT AND ORGANIZATION THEORY (3 credits)**

Only students who have been admitted to the Executive MBA program may take this course. A systematic analysis of the principles and concepts of organization and management theory including the basic process of management and the fundamentals of organization design. From a micro perspective, the course focuses on the planning, organizing, directing and controlling functions of management with emphasis on the classical, neoclassical, behavioral and systems schools of thought. From a macro perspective, the course focuses on the relationships between such factors as environment, goals, strategy, management process and organizational structure.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8470 INVESTMENT MANAGEMENT FOR EXECUTIVES (3 credits)**

Only students who have been admitted to the Executive MBA program may take this course. Investigation of the principles involved in building an investment portfolio of securities, and financial analysis of securities, and in learning practices of the securities markets.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8480 APPLICATIONS IN ECONOMICS (2 credits)**

Students will learn how to apply micro-economic concepts to corporate strategy. Topics covered include demand analysis and consumer behavior, cost efficiencies such as economies of scale and scope, market structure and strategic pricing, applications of game theory to strategy, and others. The course will also cover macroeconomic conditions and concepts that affect business decisions such as the detection, measurement, and determinants of business cycles and the resulting impact of macroeconomic policy.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8490 IT: LEVERAGING TECHNOLOGY FOR COMPETITIVE ADVANTAGE (2 credits)**

The premise of this course is that today's executives and 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)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree students.

**BSAD 8500 FINANCIAL MANAGEMENT (3 credits)**

This course is an introduction to corporate financial management. Lectures and case studies will be used to acquaint the student with financial decision-making involving such topics as capital budgeting, working capital management, financial statement analysis, capital structure policy and others. This course is required for all students working toward the Master of Business Administration degree.

**Prerequisite(s)/Corequisite(s):** Completion of MBA foundation requirements and BSAD 8060, 8100 and 8200; or admission to the MAcc program. Not open to nondegree students.

**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.

**Prerequisite(s)/Corequisite(s):** BSAD 8500. Not open to nondegree students.

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

Modern Portfolio Theory of Investment Management and its application in formulation of policies for individuals and institutional investors. Qualitative and quantitative analysis of the risks and returns of portfolio management using efficient market, fundamental and technical analysis approaches.

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

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

A comprehensive study of the structure and functioning of financial firms and markets; recent policies affecting the financial system; proposals for structural and functional changes of the financial system.

**Prerequisite(s)/Corequisite(s):** BSAD 8500. Not open to nondegree 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.

**Prerequisite(s)/Corequisite(s):** BSAD 8500. Not open to nondegree students.

**BSAD 8550 SEMINAR IN FINANCE (1-3 credits)**

Selected topics from areas of business finance.

**Prerequisite(s)/Corequisite(s):** BSAD 8500. Not open to nondegree students.



**BSAD 8560 MARKETING STRATEGIES (3 credits)**

Marketing is the core of an operating business. Marketing is the art and science of creating customer value and market place exchanges that benefit the organization and its stakeholders. It is an organizational philosophy and a set of guiding principles for interfacing with customers, competitors, collaborators, and the environment. Students will learn 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. Strategies for pricing, promoting and distributing the firm's products and services to create competitive advantage in domestic and international markets are covered.

**Prerequisite(s)/Corequisite(s):** Enrollment in UNO's Executive MBA program. Not open to non-degree graduate students.

**BSAD 8566 STATE AND LOCAL FINANCE (3 credits)**

Theoretical and policy analysis of state and local government fiscal behavior. Revenues, expenditures, borrowing and intergovernmental fiscal relations. Applications to education, transportation, and economics development. (Cross-listed with FNBK 4560).

**Prerequisite(s)/Corequisite(s):** ECON 2200 and 2220 or BSAD 8180. Not open to nondegree students.

**BSAD 8570 STRATEGIC MANAGEMENT (3 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)/Corequisite(s):** Enrollment in UNO's Executive MBA program. 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)/Corequisite(s):** Graduate standing. Not open to non-degree graduate students.

**BSAD 8580 INTERNATIONAL: COMPETING IN GLOBAL MARKETS (3 credits)**

Students will develop an understanding of the evolution of the global political economy, challenges faced when operating in the global business environment, and how to evaluate the risks and returns of global expansion. Students will also learn how to effectively communicate in international settings, to successfully manage international conflicts and to conduct effective cross-border business negotiations.

**Prerequisite(s)/Corequisite(s):** Enrollment in the Executive MBA Program. Not open to nondegree students.

**BSAD 8590 SEMINAR IN BUSINESS ADMINISTRATION (3 credits)**

This course hosts the international business consulting project. Both a theory and a practical course, it examines opportunities and challenges for a domestic U.S. firm or industry attempting to enter or expand its presence in an international market. Emphasis is placed on developing focused and appropriate research objectives, the collection and analysis of data for decision-making, development and evaluation of strategy alternatives, and on the production and presentation of a professional, prescriptive consulting report.

**Prerequisite(s)/Corequisite(s):** Admittance to the Executive MBA Program. Not open to nondegree 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 & LAND USE THEORY (3 credits)**

This course brings together the best of the technical literature dealing with the development of advanced tools of analysis and concepts of Real Estate and Land Use Economics. The tools are presented and developed which assist real estate decision-makers in identifying and evaluating professionally the complex factors which determine real estate productivity, value, investment and land-use patterns.

**Prerequisite(s)/Corequisite(s):** ECON 2200 and 2220 or BSAD 8180. Not open to nondegree students.

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

**BSAD 8610 CURRENT PROBLEMS IN REAL ESTATE AND LAND USE ECONOMICS (3 credits)**

A study of current problems in real estate markets affecting decision policies in the private and public sectors. Analysis of economics of land development and use and re-use of real property to provide a viable environment for all citizens.

**Prerequisite(s)/Corequisite(s):** RELU 2410, 4400, 4410 and LAWS 3460 or equivalent experience. Not open to nondegree students.

**BSAD 8620 VALUATION OF INTELLECTUAL PROPERTY (3 credits)**

Intellectual Property (IP) is critical to business success. Accounting, economics, and finance all struggle to quantify 'value' of individual IP (e.g., trademark) and bundles of IP (e.g., patent pool). Value depends on the context (e.g., infringement versus depreciation versus sale). This course focuses on application of theory.

**Prerequisite(s)/Corequisite(s):** BSAD 8010 or BSAD 8100 or BSAD 8110 or BSAD 8500, or its equivalents. Not open to non-degree graduate students.

**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)/Corequisite(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 INTERNATIONAL: COMPETING IN GLOBAL MARKETS (2 credits)**

This course allows students to develop an understanding of the evolution of the global political economy, challenges faced when operating in the global business environment, and how to evaluate the risks and returns of global expansion. Students will also learn how to effectively communicate in international settings, to successfully manage international conflicts, and to conduct effective cross-border business negotiations.

**Prerequisite(s)/Corequisite(s):** Enrollment in the Executive MBA Program. Not open to non-degree graduate students.

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

**BSAD 8706 ECONOMICS OF EBUSINESS (3 credits)**

The course will be conducted mainly as a seminar with ample student participation, including a research paper. A 'New Economy' has often been identified with the rise of e-business. We will examine whether the rise of e-business has brought with it a change in the rules of the economy, and we will look at the effects of e-business on business, labor, consumers, and the stock market. (Cross-listed with ECON 4700, ECON 8706.)

**Prerequisite(s)/Corequisite(s):** Admission to the MBA program or the Economics graduate program. Not open to nondegree 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)/Corequisite(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)/Corequisite(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, both as an instrument for new venture formation and as a core capability for addressing challenges in competitive landscapes. As such, the course lies at the intersection of innovation, entrepreneurship and strategy. Students will develop practical experience by experimenting with and refining business ideas. (Cross-listed with ENTR 4720, ITIN 4720, ITIN 8256, MGMT 4720, MKT 4720).

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

**BSAD 8750 TELECOMMUNICATIONS IN BUSINESS (3 credits)**

This course is designed to introduce students to basic technology of modern telecommunications, including voice, data and video, as well as the contemporary issues of telecommunication policy. In addition, the course will address managerial issues of modern telecommunications in business.

**Prerequisite(s)/Corequisite(s):** Graduate. Not open to non-degree graduate 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 as other pressing issues such as financing, staffing, product development are addressed. This course will focus on consultative solution-based sales fundamentals that can be applied in the entrepreneurial selling environment. (Cross-listed with ENTR 4760, MKT 4760)

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

**BSAD 8800 MBA PROJECT-FOCUSED CAPSTONE (2-3 credits)**

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

**Prerequisite(s)/Corequisite(s):** Students must complete this course in the final semester or within the last 9 hours of their MBA program courses. A minimum B grade required to complete the course successfully and qualify for graduation. Not open to non-degree graduate students.

**BSAD 8810 APPLIED STRATEGIC LEADERSHIP (3 credits)**

Applied and integrative course in the MBA program, with an emphasis on field experiences when possible.

**Prerequisite(s)/Corequisite(s):** Concurrent enrollment in, or completion of, BSAD 8060. Not open to nondegree students.

**BSAD 8820 SUSTAINABLE BUSINESS PRACTICES (1 credit)**

This course exposes students to motivations for, and implications of business engagement in, sustainable management practices. As such the course addresses why firms have increasingly been investing in energy and natural resource conservation, recycling, green products, green branding, and environmental impact mitigation. This course addresses a firm's market-based incentives to grow profits, gain market share and/or otherwise differentiate themselves from their competition through green initiatives.

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

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

Individual research in an academic area in business administration.

**Prerequisite(s)/Corequisite(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 8910 SPECIAL TOPICS IN BUSINESS (1-3 credits)**

May be repeated up to (6). A series of special courses each designed to focus on current major topics and developments in a specific area of economics or business, scheduled as a workshop or seminar according to purpose.

**Prerequisite(s)/Corequisite(s):** Graduate in good standing and as indicated for specific workshop or seminar. Not open to non-degree graduate students.

**BSAD 8916 SPECIAL TOPICS IN ECONOMICS (1-3 credits)**

(May be repeated up to 6) A series of special courses each designed to focus on current major topics and developments in a specific area of economics or business, scheduled as a workshop or seminar according to purpose. (Cross-listed with ECON 8916, ECON 4910).

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

**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 order of 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)**

Review of the basic concepts of graph theory. Introduction to perfect graphs and their characterizations. Main classes of perfect graphs and their properties. Algorithms for main problems of perfect graphs. Applications of perfect graphs in several fields such as scheduling, VLSI and communication networks. (Cross-listed with MATH 8050).

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

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

The study of algorithms important in computer programming. Principles and underlying concepts of algorithm design, fundamental techniques of algorithm analysis, typical types of algorithms and computer architecture. (Cross-listed with MATH 8080).

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

**CSCI 8100 EXPERT SYSTEMS (3 credits)**

A study of the theoretical basis and practical design of expert systems. Knowledge engineering. Foundations in logic programming, the architecture of expert systems, languages (Prolog, LISP) for expert systems, expert system shells, knowledge acquisition, current issues.

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

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

Various parallel architectures, models of parallel computation, processor arrays, multiprocessor systems, pipelined and vector processors, dataflow computers and systolic array structures.

**Prerequisite(s)/Corequisite(s):** CSCI 4350, CSCI 4500 and graduate.

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

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

Introduction to the principle concepts of integrated circuit layout. Presentation of the hardware foundations, algorithmic mathematical and graph theoretical foundations of circuit layout. Partitioning problems in integrated circuits. Placement and floor planning phase in layout. Routing algorithms and compaction techniques. Applications of graph theory in several steps of the design process of VLSI circuits.

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

**CSCI 8170 VLSI TESTING (3 credits)**

This course covers topics in VLSI testing. In particular, topics covered include fault modeling, fault simulation, test generation, testability profiles, built-in tests, and binary decision diagrams.

**Prerequisite(s)/Corequisite(s):** Bachelors degree and permission from the Graduate Program Committee; CSCI 4350. Not open to non-degree graduate students.

**CSCI 8200 INTERCONNECTION NETWORKS (3 credits)**

This course is to introduce the technology of interconnection networks from topology of networks, through routing and flow control, to a discussion of hardware/software fault tolerance, and to understand parameters affecting performance.

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

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

**CSCI 8220 TELECOMMUNICATIONS MANAGEMENT (3 credits)**

This course will focus on the management required to operate today's complex telecommunications networks. The course will be based on the standards that are currently in place as well as examining the future directions. The student, upon the successful completion of this course, will have: an operational knowledge of the components of complex telecommunications networks, the management structures and computer systems needed to maintain that network, and the security solutions used to protect that network. (Cross-listed with ISQA 8230)

**Prerequisite(s)/Corequisite(s):** Acceptance into the Graduate program of CSCI or MIS or by permission of the instructor. 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, ITIN 4260, ITIN 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)/Corequisite(s):** CSCI 1620 and CSCI 3220. Not open to non-degree graduate students.

**CSCI 8305 NUMERICAL METHODS (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 3300, MATH 3300, MATH 8305).

**Prerequisite(s)/Corequisite(s):** MATH 1960 with a C- or better or permission of instructor

**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)/Corequisite(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)/Corequisite(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 8340 DATABASE MANAGEMENT SYSTEMS II (3 credits)**

A continuation of the study of Data Base Management Systems. Extended discussion of logical data base design, normalization theory, query optimization, concurrent issues. Advanced topics including distributed data bases, deductive data bases, data base machine, and others.

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

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

Covers topics related to decision support queries. In particular, topics covered include building data warehouses, On-Line Analysis Processing (OLAP), maintenance of materialized views, indexing, various data mining techniques, and integration of OLAP and data mining.

**Prerequisite(s)/Corequisite(s):** CSCI 8856; bachelors degree and permission from Graduate Committee. Not open to non-degree graduate students.

**CSCI 8360 INFORMATION STORAGE AND RETRIEVAL (3 credits)**

The course presents basic techniques for analyzing, indexing, representing, storing, searching, retrieving, and presenting desired information in information storage and retrieval systems. Models, document processing, thesauri, evaluation of system effectiveness, as well as special hardware will be discussed. Selected advanced topics will also be covered.

**Prerequisite(s)/Corequisite(s):** CSCI 4850 or CSCI 8856; bachelors degree and permission from Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8366 FOUNDATIONS OF CYBERSECURITY (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)

**Prerequisite(s)/Corequisite(s):** CSCI 3320 or CSCI 8325 OR ISQA 3400 OR By instructor permission

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

An in-depth study of one or more topics in the field of Data Base Management Systems, such as logical and/or physical data base design, query optimization, distributed data bases, intelligent knowledge-based systems, emerging technologies and applications. May be repeated with different topics with permission of adviser.

**Prerequisite(s)/Corequisite(s):** CSCI 4850 or CSCI 8856 or equivalent. 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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** CSCI 4830 or 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)/Corequisite(s):** CSCI 8366 or equivalents, or instructor permission. Not open to non-degree graduate students.

**CSCI 8440 SECURE SYSTEMS ENGINEERING (3 credits)**

This course takes a global risk-based view of the process of defining, verifying, validating and continuously monitoring secure information systems. The course will investigate a number of secure system solutions, starting with the definition of the system security needs, and tracing through methods of verification and validation of security controls, as well as ways to continuously monitor the corresponding assurances. (Cross-listed with CYBR 8440)

**Prerequisite(s)/Corequisite(s):** CSCI 8366 or IASC 8366

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

Need for higher-performance computers. Topics discussed include: classification of parallel computers; shared-memory versus message passing matchings; for ms of parallelism, measure 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)/Corequisite(s):** CSCI 4500 or CSCI 8506 (May be taken concurrently). Not open to non-degree graduate students.

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

**CSCI 8456 INTRODUCTION TO 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 using Bayesian networks, temporal reasoning, planning under uncertainty and machine learning. (Cross-listed with CSCI 4450).

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

**CSCI 8510 NUMERICAL ANALYSIS II (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)/Corequisite(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)/Corequisite(s):** MATH 4300 or MATH 8306 or CSCI 4300 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. (Cross-listed with CSCI 4510)

**Prerequisite(s)/Corequisite(s):** CSCI 4500/8506. Not open to nondegree students.

**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)/Corequisite(s):** CSCI 3320 or CSCI 8325 with C- or better. Data structures and algorithms. C or C++ programming.

**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)/Corequisite(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 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)/Corequisite(s):** CSCI 4500 and CSCI 4350. Not open to non-degree graduate students.

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

Contemporary issues in mobile computing and wireless networks, including 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, using the spectrum, wireless data networks, various network layers solutions, location management techniques, mobile IP, wireless LANs, wireless TCP, ad hoc networks, performance issues, security issues.

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

**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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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, MATH 4760, MATH 8766).

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

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

An in-depth study of one or more topics in the field of software engineering such as human factors in software engineering, software specifications and modeling, reuse and design recovery, software valuations, software management, emerging technology and applications.

**Prerequisite(s)/Corequisite(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 8850 ADVANCED AUTOMATA AND FORMAL LANGUAGES (3 credits)**

A continuation of MATH 4660/MATH 8666/CSCI 4660/CSCI 8666. The course will be an introduction to Computational Complexity. Topics that will be covered include space and time complexities of Turing Machines, deterministic versus non-deterministic machines, NP-Complete problems, alternating Turing machines, and concepts of reducibility. (Cross-listed with MATH 8850).

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

**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)/Corequisite(s):** CSCI 3320 or permission of instructor. 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** Permission of the Graduate Program Committee. Not open to non-degree graduate students.

**CSCI 8980 GRADUATE SEMINAR (1-3 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 computer science.

Topics to be covered by the course will vary in different semesters.

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

**CSCI 8986 TOPICS IN COMPUTER SCIENCE (1-3 credits)**

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. (Cross-listed with CSCI 4980).

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

**CSCI 9210 TYPE SYSTEMS BEHIND PROGRAMMING LANGUAGES (3 credits)**

Empirical evidence suggests that a large number of errors made when writing software can be detected by analyzing the behavior of the program from the perspective of type. This course provides an in-depth exploration of various type systems for programming languages.

**Prerequisite(s)/Corequisite(s):** CSCI 8000. Not open to non-degree graduate students.

**CSCI 9220 REWRITING AND PROGRAM TRANSFORMATION (3 credits)**

This course begins by exploring the foundations of term rewriting. Topics such as unification, confluence, completion and termination are covered. Then a strategic framework is considered in which the application of rewrite rules can be controlled.

**Prerequisite(s)/Corequisite(s):** CSCI 8000. Not open to non-degree graduate students.

**CSCI 9350 MATHEMATICAL AND LOGICAL FOUNDATIONS OF DATA MINING (3 credits)**

With the maturity of data mining techniques, it is extremely important to examine the foundations of data mining. Instead of providing coverage of basic data mining methods, the course will focus on methodology employed in data mining, logical and mathematical foundations of data mining, as well as other issues related to the intrinsic nature of data mining.

**Prerequisite(s)/Corequisite(s):** CSCI 8456, CSCI 8856, and CSCI 8390. 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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 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 will be emphasized.

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

**ECON 8020 ENVIRONMENTAL ECONOMICS AND MANAGEMENT (3 credits)**

This course covers topics related to environmental economics and policy, with an emphasis on comparative policy analysis and business strategies towards the environment. (Cross-listed with BSAD 8020).

**Prerequisite(s)/Corequisite(s):** ECON 2200 and ECON 2220 or BSAD 8180, or permission of the instructor. Not open to non-degree graduate students.

**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 public school teacher (K-12) with sufficient background and understanding to aid in the recognition of economic issues and the teaching of economic concepts and principles.

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



**ECON 8160 SEMINAR IN LABOR ECONOMICS (3 credits)**

A study of the demand for labor, the supply of labor, the theory of compensating differentials, investment in human capital, worker mobility, discrimination, unions, inequality and unemployment.

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

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

This course deals with the current state of microeconomic theory. The major topics covered are the theory of consumer behavior, theory of production and cost, theory of the firm, distribution theory and welfare theory.

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

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

Microeconomics for graduate students of business. Economic analysis of the business firm and its environments, with emphasis on market structure, production possibilities and cost factors. Additional consideration is given to the theory of the firm under conditions of uncertainty. (Cross-listed with BSAD 8100).

**Prerequisite(s)/Corequisite(s):** Graduate student in economics and ECON 2200 or equivalent.

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

This course applies economic analysis to public policy issues in industrial economics. It is concerned with the strategic behavior of firms: the nature of interaction among competing firms within a game-theory framework. Among the topics covered are: discriminatory pricing, predatory conduct, product design, patent infringement, price wars, location decisions, and entry-deterrence. (Cross-listed with ECON 4210).

**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)/Corequisite(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, and the adaptation of business policies to changing business conditions. Emphasis is placed upon the practical application of statistical techniques of analysis to the business situation, within the framework of the aggregate economy.

**Prerequisite(s)/Corequisite(s):** ECON 2200 or BSAD 8180.

**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)/Corequisite(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)/Corequisite(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. (Cross-listed with ECON 4300).

**Prerequisite(s)/Corequisite(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. We will cover traditional Econometric forecasting methods in the first half of the class. In the second half of the course, we will focus on models in predictive analytics and machine learning, since these models are quickly becoming critical tools for forecasters in many settings. The course will include lecture and lab time, and labs will be focused on teaching students how to implement the models discussed in lectures. (Cross-listed with BSAD 8080).

**Prerequisite(s)/Corequisite(s):** ECON 8320 (or equivalent programming experience) AND ECON 8300 (or equivalent multivariate regression analysis coursework) 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)/Corequisite(s):** ECON 3310 OR ECON 8320 (or concurrent enrollment) AND 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)/Corequisite(s):** ECON 2200 or BSAD 8150 (or equivalent); BSAD 2130 or equivalent; or instructor approval.

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

Energy, minerals, fisheries, water, land, pollution and congestion are among the topics. The course covers the basic theoretical framework for understanding the optimal rate of resource use, identifies the factors which determine the actual rate of use, and considers and evaluates various public policy prescriptions. (Cross-listed with ECON 4320).

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

**Prerequisite(s)/Corequisite(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 8346 ECONOMICS OF TECHNOLOGY (3 credits)**

The seminar discusses whether innovation is more driven by demand or supply forces, the optimal timing of adoption of new technology, whether new technology benefits workers and consumers, and whether government is successful at supporting promising new technology. (Cross-listed with ECON 4340).

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

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

Monetary policy has an important effect on economic magnitudes, including the level of output, interest rates, inflation rates, exchange rates, and many other variables. This course provides an in-depth analysis of the role that the Federal Reserve plays in our economy. This involves how monetary policy is transmitted to various markets. (Cross-listed with ECON 4450).

**Prerequisite(s)/Corequisite(s):** ECON 3220, or permission of the instructor.

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

**ECON 8600 HEALTH ECONOMICS (3 credits)**

This course is designed to help students understand how the theories and models of economics can be applied to the study of health and health care. The examination of the markets (demand and supply) for health, health care and health insurance is stressed. In addition, the economic analytic tools such as microeconomic theories and economic evaluation methods also will be reviewed and introduced. The objective of this course is to equip students with the knowledge tools to examine and analyze the problems issues of health care from the perspective of economics.

**Prerequisite(s)/Corequisite(s):** ECON 2200 or equivalent.

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

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

An analysis of the international monetary system. Subjects covered include the balance of payments adjustment mechanism, alternative exchange rate systems, external effects of monetary and fiscal policy, foreign investments and international monetary reform. (Cross-listed with ECON 4620).

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

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

Problems relating to early stages of economic development; investment priorities, mobilizing savings and policies and programs are studied. (Cross-listed with ECON 4660).

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

**ECON 8706 ECONOMICS OF EBUSINESS (3 credits)**

The course will be conducted mainly as a seminar with ample student participation, including a research paper. A 'New Economy' has often been identified with the rise of e-business. We will examine whether the rise of e-business has brought with it a change in the rules of the economy, and we will look at the effects of e-business on business, labor, consumers, and the stock market. (Cross-listed with ECON 8706, BSAD 8706).

**Prerequisite(s)/Corequisite(s):** Admission to the MBA program or the Economics graduate program or permission of the 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)/Corequisite(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)/Corequisite(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 (1-3 credits)**

(May be repeated up to 6) A series of special courses, each designed to focus on current major issues and developments in a specific area of economics or business, scheduled as a workshop or seminar according to purpose.

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

**ECON 8916 SPECIAL TOPICS IN ECONOMICS (1-3 credits)**

(May be repeated up to 6 hours) A series of special courses each designed to focus on current major topics and developments in a specific area of economics or business, scheduled as a workshop or seminar according to purpose. (Cross-listed with BSAD 8916, ECON 4910).

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

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

Guided independent study and research under tutorial supervision.

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

**ECON 8930 INDEPENDENT STUDY (1-3 credits)**

Guided independent study and research under tutorial supervision.

**Prerequisite(s)/Corequisite(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)/Corequisite(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.

**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 of 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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** CIST 2500, CIST 2100, and ISQA 8040, or permission of the instructor.

**ISQA 8080 SEMINAR IN MANAGEMENT INFORMATION SYSTEMS (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.

**Prerequisite(s)/Corequisite(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)/Corequisite(s):** Permission of instructor. Additional prerequisites may be required for particular topic 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** ISQA 4150 or ISQA 8156

**ISQA 8166 INTRODUCTION TO ENTERPRISE RESOURCE PLANNING (3 credits)**

Introduction to Enterprise Resource Planning (ERP) is designed to expose students to the primary enterprise application that forms the information systems (IS) infrastructure for most large organizations today. The primary purpose of this course is for students to gain an understanding of the enterprise wide, cross functional nature of ERP software. In the process of learning about ERPs, the students develop 'hands on' experience with the largest and most well-known ERP application, SAP. (Cross-listed with ISQA 4160, SCMT 4160)

**Prerequisite(s)/Corequisite(s):** CIST 2100 or equivalent. Not open to non-degree graduate students.

**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)/Corequisite(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)/Corequisite(s):** CIST 2500 and CIST 2100.

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

**ISQA 8230 TELECOMMUNICATIONS MANAGEMENT (3 credits)**

This course will focus on the management required to operate today's complete telecommunications networks. The course will be based on the standards that are currently in place as well as examining the future directions. The student, upon the successful completion of this course, will have: an operational knowledge of the components of complex telecommunications networks, the management structures & computer systems needed to maintain that network, and the security solutions used to protect that network. (Cross-listed with CSCI 8220)

**Prerequisite(s)/Corequisite(s):** Acceptance into the graduate program of MIS or CSCI or by permission of the instructor. Not open to non-degree graduate students.

**ISQA 8250 FACILITATION OF COLLABORATIVE PROBLEM SOLVING (3 credits)**

The course focuses on the facilitation of collaborative problem solving and decision making processes. Students learn how to design and facilitate collaborative workshops, with support from both paper-based and electronic meeting tools. The course is hands-on and experiential, with students working in small teams to conduct real workshops.

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

**ISQA 8510 MANAGING USABILITY FUNCTIONS IN SYSTEMS DEVELOPMENT ORGANIZATION (3 credits)**

This course deals with usability of information systems, from the perspective of organizing and managing usability functions in a systems development organization. After briefly introducing the background to system usability and usability principles, the course focuses specifically on the introduction, organization, support, management and evaluation of usability functions in systems development organizations. The role of the usability professional in the organization is emphasized.

**Prerequisite(s)/Corequisite(s):** Two semesters of programming or demonstrable experience and ISQA 8040 or equivalent, not open to non-degree graduate students.

**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)/Corequisite(s):** CIST 1300

**ISQA 8530 E-COMMERCE SECURITY (3 credits)**

The course will integrate concepts, principles, and technologies from business, telecommunications, and computer science to identify, understand, and propose solutions to the security threats to e-commerce.

**Prerequisite(s)/Corequisite(s):** CIST 2100 and ISQA 8310. Not open to non-degree graduate students.

**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 CIST4540, CYBR 4540, CYBR 8546)

**Prerequisite(s)/Corequisite(s):** IASC 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)/Corequisite(s):** CIST 2100 or BSAD 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)/Corequisite(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)/Corequisite(s):** ISQA 8060 and ISQA 8546 or equivalents, not open to non-degree graduate students.

**ISQA 8596 IT AUDIT AND CONTROL (3 credits)**

This course explores organizational and managerial issues relevant to planning and conducting IT audit and control activities. The course covers the following conceptual areas: business risks and the management of business risk, IT risk as a component of business risk, the need to manage IT risks, and the basic type of controls required in a business system in order to control IT risks. Issues associated with new risks created by the use of the internet for business applications and electronic business are also covered. (Cross-listed with ISQA 4590)

**Prerequisite(s)/Corequisite(s):** A solid understanding of business foundations such as accounting and introductory auditing and exposure to the IS discipline is essential for success in this course. Permission of instructor is required to enroll.

**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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** CIST 2100 or equivalent.

**ISQA 8750 DATA VISUALIZATION: 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)/Corequisite(s):** CSCI 1620 or equivalent. Admission into the UNO graduate program, basic web development or work experience with comparable grounding in programming, 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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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 the 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. Major topics include: foundations of behavioral and organizational research in Information Systems; general research on systems design and problem solving; cognitive perspectives; decision making processes; human aspects of computing; computer-mediated communication; systems development; IS implementation; organizational change; organizational structure and new forms; information systems adoption; management of the information systems function; social, cultural, and ethical issues in information systems; and project management.

**Prerequisite(s)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** Admission to PhD program in Information Technology or permission of instructor

**ITIN 8000 TECHNOLOGY & INNOVATION-STATE OF THE ART (0 credits)**

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

**Prerequisite(s)/Corequisite(s):** Students in the MS in IT Innovation program may register. Not open to non-degree graduate students.

**ITIN 8006 SPECIAL TOPICS IN IT INNOVATION (1-6 credits)**

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

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

**ITIN 8100 INTERMEDIA (3 credits)**

This is an ongoing course that brings together students of the arts and students of scientific disciplines in order to facilitate and promote the creation of intermedia art, and to further explore shared resources, joint research, and exhibition/performance opportunities.

**Prerequisite(s)/Corequisite(s):** Instructor permission

**ITIN 8210 DESIGN SCIENCE AND THEORY DEVELOPMENT (3 credits)**

The purpose of this course is to help students understand theory, theoretical contributions, and design science. Students will approach such questions as: What is a theory? What makes a good theory? Why are theories just theories and not laws? What is not a theory? Following this introduction, we explore design science as a research methodology and Information Technology design theories. Ultimately, students create their own new studies around some design concept.

**Prerequisite(s)/Corequisite(s):** Graduate standing / permission of the instructor

**ITIN 8220 DESIGN PROCESS (3 credits)**

Inter-disciplinary design teams will work together to design and innovate products of the future. The design projects in the course are developed to directly address a problem brought forward by a technology company in the Omaha area in order to provide students with a design experience that directly impacts real-world product development. Students will focus on the technological (interface), physical (ergonomics) and aesthetic quality of design, and will learn how to conduct rigorous user studies in a laboratory setting. Teams will be cross disciplinary and consider all aspects of the design, creation, testing, and fabrication of the products.

**ITIN 8256 INNOVATION VENTURES (3 credits)**

This team-based course provides students with the opportunity to practice the basic tools of business discovery and validation, both as an instrument for new venture formation and as a core capability for addressing challenges in competitive landscapes. As such, the course lies at the intersection of innovation, entrepreneurship and strategy. Students will develop practical experience by experimenting with and refining business ideas. (Cross-listed with BSAD 8726, ENTR 4720, ITIN 4720, MGMT 4720, MKT 4720).

**Prerequisite(s)/Corequisite(s):** Admission to a graduate program or instructor permission.

**ITIN 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, CSCI 8266, ITIN 4260).

**ITIN 8300 RESEARCH FOUNDATIONS (3 credits)**

This course serves as an introduction to research literature and research methodology in the innovation and creativity research domain. Students are introduced to skills, methodological issues, and bibliographic resources to enhance their ability in critically evaluating and conducting research in the IT Innovation field. Through a series of readings, in-class discussions, and lectures the student will select and define a research question, explore the various types of research designs and complete a literature review. This course is structured to make research meaningful and significant and enable students to write effectively.

**Prerequisite(s)/Corequisite(s):** CIST 2500 or equivalent

**ITIN 8900 INDEPENDENT STUDIES (1-3 credits)**

A variable credit course for the graduate student who will benefit from independent reading assignments and research type problems. Independent study makes available courses of study not available in scheduled course offerings. The student wishing to take an independent study course should find a faculty member willing to supervise the course and then submit, for approval, a written proposal (including amount of credit) to the IT Innovation Graduate Program Committee Chair at least three weeks prior to registration.

**Prerequisite(s)/Corequisite(s):** Written permission required

**ITIN 8940 ITIN CAPSTONE I (3 credits)**

The purpose of the Information Technology Innovation (ITIN) capstone courses is for ITIN majors to explore, identify, evaluate, design, construct and implement a new innovative product that leverages information technology and includes an interdisciplinary field of study. The capstone is the culmination product of the specific various disciplines a student has selected as the unique combination for his or her degree. This course serves as part one of the capstone project for the ITIN Masters degree. The two courses for the ITIN capstone project are intended to be completed in two consecutive semesters (Fall/Spring).

**Prerequisite(s)/Corequisite(s):** Must be pursuing ITIN MS degree and have completed: two sections of ITIN 8000, ITIN 8220, 8300, and 3 hours of upper division courses in interdisciplinary area identified in the student's course plan. Not open to non-degree graduate students.

**ITIN 8950 ITIN CAPSTONE II (3 credits)**

The purpose of the ITIN capstone courses is for ITIN majors to explore, identify, evaluate, design, construct and implement a new innovative product that leverages information technology and an interdisciplinary field. The capstone is the culmination product for prospective graduate and utilizes the discipline(s) a student has selected as the unique combination for his or her degree. This course serves as part two of the capstone project for the Information Technology Innovation (ITIN) program. The two courses for the ITIN capstone project are taught in two consecutive semesters.

**Prerequisite(s)/Corequisite(s):** Must be pursuing ITIN MS degree and have completed: three sections of ITIN 8000, ITIN 8220, 8300, 8940 and 6 hours of upper division courses in interdisciplinary area identified in the student's course plan. Not open to non-degree graduate students.

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

This course is required for the Master of Science degree in the MS in IT Innovation Program. The purpose of this course is to conduct original research in IT Innovation, under supervision of a faculty member, culminating in a paper document that represents the student's competency in their chosen field, as well as scholarly contributions. With consultation from their committee, MS in IT Innovation thesis students should be prepared to independently complete the writing of their thesis and successfully defend their thesis.

**Prerequisite(s)/Corequisite(s):** Graduate major in ITIN and approval of the Thesis Advisory Committee.

**ITIN 9300 SOCIAL COMPUTING AND ITS APPLICATIONS (3 credits)**

It is indisputable that social media and the Internet more broadly reshaped information disbursement and processing. Digital participation and communication has become the 'new normal' and the dividing line between off- and online communities is increasingly blurred. This leads to specific challenges in the extraction and analysis of online social media data, and the management of new communication.

**Prerequisite(s)/Corequisite(s):** Open to all currently-admitted doctoral students. Students should have a technical aptitude; experience with at least one web scripting language, (e.g. PHP, rails, python etc) is helpful. Experience with JSON is advantageous but not essential.

**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)/Corequisite(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)/Corequisite(s):** MATH 2230 with a C- or better or MATH 2030 with a C- or better

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

Review of the basic concepts of graph theory. Introduction to perfect graphs and their characterizations. Main classes of perfect graphs and their properties. Algorithms for main problems of perfect graphs. Applications of perfect graphs in several fields such as scheduling, VLSI and communication networks. (Cross-listed with CSCI 8050).

**Prerequisite(s)/Corequisite(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)/Corequisite(s):** MATH 2050; MATH 2030 or MATH 2230 or equivalent; 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)/Corequisite(s):** MATH 3100, CSCI 3100, MATH 8105 or CSCI 8105 or instructor's permission.

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

The study of algorithms important in computer programming. Principles and underlying concepts of algorithm design, fundamental techniques of algorithm analysis, typical types of algorithms. Related topics such as algorithms and computer architecture. (Cross-listed with CSCI 8080).

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

**MATH 8235 INTRODUCTION TO ANALYSIS (3 credits)**

Provides a theoretical foundation for the concepts of elementary calculus. Topics include the real number system, topology of the real line, limits, functions of one variable, continuity, differentiation, integration. (Cross-listed with MATH 3230).

**Prerequisite(s)/Corequisite(s):** MATH 1970, and MATH 2030 or MATH 2230 or equivalent.

**MATH 8236 MATHEMATICAL ANALYSIS I (3 credits)**

Provides a theoretical foundation for the concepts of elementary calculus. Topics include ordered fields and the real number system, basic properties of complex numbers, metric space topology, sequences and series in  $\mathbb{R}$ , limits and continuity in a metric space, monotonic functions. (Cross-listed with MATH 4230).

**Prerequisite(s)/Corequisite(s):** MATH 3230/MATH 8235 or equivalent

**MATH 8246 MATHEMATICAL ANALYSIS II (3 credits)**

Provides a theoretical foundation for the concepts of elementary calculus. Topics include differentiation and Riemann-Stieltjes Integration, sequences and series of functions, uniform convergence, power series, functions of several variables, Implicit Function Theorem. (Cross-listed with MATH 4240).

**Prerequisite(s)/Corequisite(s):** MATH 4230/MATH 8236

**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)/Corequisite(s):** MATH 1970, MATH 2350, or instructor's permission. MATH 4330/MATH 8336 is recommended, but not required.

**MATH 8276 COMPLEX VARIABLES (3 credits)**

Differentiation, integration and power series expansions of analytic functions, conformal mapping, residue calculus, and applications. (Cross-listed with MATH 4270).

**Prerequisite(s)/Corequisite(s):** MATH 3230/MATH 8235 or equivalent

**MATH 8305 NUMERICAL METHODS (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 3300, CSCI 8305, MATH 3300).

**Prerequisite(s)/Corequisite(s):** MATH 1960 with a C- or better or permission of 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)/Corequisite(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)/Corequisite(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. Topics include scripting to guide optimization software, metaheuristics for optimization, and basic machine learning algorithms. (Cross-listed with MATH 4320).

**Prerequisite(s)/Corequisite(s):** MATH 3200 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)/Corequisite(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)/Corequisite(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, Lyapunov exponents, fractals, chaos, state reconstruction from time series data.

**Prerequisite(s)/Corequisite(s):** Permission from Instructor

**MATH 8406 FINITE ELEMENT METHODS FOR SOLVING ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (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)/Corequisite(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 3300/MATH 8305 and MATH 4330/MATH 8336 are recommended, but not required. Familiarity with MATLAB programming is assumed.

**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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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, model creation, developing solution algorithms, and applications of integer programming.

**Prerequisite(s)/Corequisite(s):** MATH 2030 or MATH 2230 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)/Corequisite(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)/Corequisite(s):** MATH 1960 and MATH 2050, or permission of instructor. Familiarity with computer programming is assumed.

**MATH 8505 SELECTED TOPICS IN MATHEMATICS (1-6 credits)**

This is a variable content course with selected topics in the mathematical sciences which may be of interest to students in other disciplines such as mathematics education, psychology and business. The course may be taken more than once for credit provided topics differ, with a maximum credit of nine hours. Mathematics majors may apply no more than three hours of MATH 3500 toward the minimum major requirements. MATH 8505 does not apply to M.A. or M.S. in mathematics. (Cross-listed with MATH 3500).

**Prerequisite(s)/Corequisite(s):** Permission of instructor

**MATH 8510 NUMERICAL ANALYSIS II (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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(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)/Corequisite(s):** MATH 2230

**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)/Corequisite(s):** MATH 4740/MATH 8746, MATH 4760/MATH 8766/CSCI 4760/CSCI 8766, 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)/Corequisite(s):** MATH 2030. Recommended: CSCI 3320/CSCI 8325.

**MATH 8670 TOPICS IN PROBABILITY AND STATISTICS (3 credits)**

A variable topics course in probability and or statistics. Topics covered will include one or more of the following: reliability theory and applications in engineering and science, advanced probability and statistical models, theory of parametric estimation and applications, and advanced probability theory and application.

**Prerequisite(s)/Corequisite(s):** MATH 4740/MATH 8740 or STAT 3800/STAT 8800 or permission from instructor

**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).

**MATH 8756 INTRODUCTION TO PROBABILITY AND STATISTICS II (3 credits)**

Theory and methods of statistical inference including estimators, statistical hypotheses, multivariate estimation, chi-square tests, analysis of variance, and statistical software. (Cross-listed with MATH 4750).

**Prerequisite(s)/Corequisite(s):** MATH 4740/MATH 8746

**MATH 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, CSCI 8766, MATH 4760).

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

**MATH 8850 ADVANCED AUTOMATA AND FORMAL LANGUAGES (3 credits)**

A continuation of MATH 4660/MATH 8666/CSCI 4660/CSCI 8666. The course will be an introduction to computational complexity. Topics that will be covered include space and time complexities of Turing Machines, deterministic versus non-deterministic machines, NP-Complete problems, alternating Turing machines, and concepts of reducibility. (Cross-listed with CSCI 8850).

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

**MATH 8855 HISTORY OF MATHEMATICS (3 credits)**

An overview of the historical development of mathematical concepts and methods. Brief biographies of major mathematicians, descriptions of the cultural context of selected major advances, and examples of the solution of problems using the knowledge and methods appropriate for each time period will be included. (Cross-listed with MATH 3850).

**Prerequisite(s)/Corequisite(s):** Students who enroll in this course should have completed MATH 1970 and MATH 2230 in order to have the minimum amount of mathematical background needed to appreciate the mathematical content of the course.

**MATH 8880 ADVANCED PLACEMENT INSTITUTE: CALCULUS (3 credits)**

A workshop for teachers planning to offer an advanced placement course in calculus. Objectives include increasing teacher competencies in single-variable calculus, discussion and study of AP calculus exams, implementations of AP courses in calculus, and development and presentation of projects for graduate credit. (This course will not count toward the M.A. or M.S. degrees in Mathematics.)

**Prerequisite(s)/Corequisite(s):** Graduate in mathematics or mathematics education.

**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)/Corequisite(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)/Corequisite(s):** Permission of instructor and graduate classification.

**MATH 8980 GRADUATE SEMINAR (1-3 credits)**

A graduate seminar in mathematics.

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

Master's Thesis.

**MATH 9110 ADVANCED TOPICS IN APPLIED MATHEMATICS (3 credits)****MATH 9230 THEORY OF FUNCTION OF REAL VARIABLES (3 credits)**

Real number system, convergence, continuity, bounded variation, differentiation, Lebesgue-Stieltjes integration, abstract measure theory, the  $L_p$  spaces.

**Prerequisite(s)/Corequisite(s):** MATH 4230/MATH 8236 and MATH 8240 or equivalent.

**STAT 8005 STATISTICAL METHODS I (3 credits)**

Distributions, introduction to measures of central value and dispersion, population and sample, the normal distribution, inference: single population, inference: two populations, introduction to analysis of variance. Statistical packages on the computer will also be utilized in the course. (Cross-listed with STAT 3000)

**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)/Corequisite(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)/Corequisite(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, & 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)/Corequisite(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)/Corequisite(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, & CSCI 1620 or MATH 3200 with a grade of 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)/Corequisite(s):** MATH 4740/8746 with a C- or better or STAT 3800/8805 with a C- or better or permission of 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)/Corequisite(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)/Corequisite(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.

**Prerequisite(s)/Corequisite(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 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, linear regression, contingency tables. Credit for both MATH 4740 and STAT 3800 will not be given. (Cross-listed with STAT 3800)

**Prerequisite(s)/Corequisite(s):** MATH 1970

**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)/Corequisite(s):** Permission of faculty advisor and graduate program chair. Not open to non-degree graduate students.