

M.S. with a Major in Operations Research

Candidates must satisfy a total of 30 hours (CH) with a minimum G.P.A. of 3.000 on a 4.000 scale.

All students must complete 21 credit hours (CH) of the required curriculum.

Probability and Statistics (one of the following)

EMIS 7370 Probability and Statistics for Scientists and Engineers

Introduces fundamentals of probability, probability distributions, and statistical techniques used by engineers and physical scientists. Topics include basic concepts and rules of probability, random variables, probability distributions, expectation and variance, sampling and sampling distributions, statistical analysis techniques, statistical inference estimation and tests of hypothesis, correlation and regression, and analysis of variance. *Prerequisite:* Knowledge of calculus.

EMIS 7377 (STAT 5377) Statistical Design and Analysis of Experiments

Introduction to statistical principles in the design and analysis of industrial experiments. Completely randomized, randomized complete and incomplete block, Latin square, and Plackett-Burman screening designs. Complete and fractional experiments. Descriptive and inferential statistics. Analysis of variance models. Mean comparisons. *Prerequisites:* EMIS 4340 and senior standing with a science or engineering major, or permission of instructor.

Core Courses (three of the following)

EMIS 7362 Production Systems Engineering

Applies the principles of engineering, or “design under constraint,” to modern production systems. Topics include production systems analysis and design considerations, system design and optimization models and methods, pull- and push-based production systems, quality engineering, and process improvement. Also, techniques for engineering and managing systems with specific architectures: batch-oriented, continuous-flow, projects, and just-in-time. *Prerequisite:* EMIS 8360 recommended.

EMIS 8360 Operations Research Models

A survey of models and methods of operations research. Deterministic and stochastic models in a variety of areas will be covered. Credit is not allowed for both EMIS 3360 and EMIS 8360. *Prerequisites:* A knowledge of linear algebra and an introduction to probability and statistics.

EMIS 8371 Linear Programming

A complete development of theoretical and computational aspects of linear programming. *Prerequisite:* Knowledge of linear algebra is required.

Depth Courses (three of the following)

EMIS 7331 Data Mining

Introduces data mining techniques (classification, association analysis, and cluster analysis) used in analytics. All material covered is reinforced through hands-on experience using state-of-the-art tools to design and execute data mining processes. *Prerequisites:* CSE 1342 or equivalent, CSE 4340/EMIS 3340/STAT 4340, or CSE 7370/EMIS 7370.

EMIS 7361 Computer Simulation Techniques

Introduction to the design and analysis of discrete probabilistic systems using simulation. Emphasizes model construction and a simulation language. *Prerequisites:* Programming ability and an introduction to probability or statistics.

EMIS 7373 Supply Chain Operation and Control

Quantitative models and approaches for operating and managing modern supply chain systems and practices with an emphasis on capacity management, production/supply planning, inventory control, distribution, and pricing applications. *Prerequisites:* EMIS 7370 and EMIS 8360.

EMIS 8331 Advanced Data Mining

Provides a review of several data mining topics and an in-depth technical discussion of advanced data mining techniques. Studies research methods used in the data mining field. *Prerequisite:* EMIS 7332.

EMIS 8361 Engineering Economics and Decision Analysis

Introduction to economic analysis methodology. Topics include engineering economy and cost concepts, interest formulas and equivalence, economic analysis of alternatives, technical rate-of-return analysis, and economic analysis under risk and uncertainty. Credit is not allowed for both EMIS 2360 and EMIS 8361. *Prerequisite:* Knowledge of introductory probability and statistics.

EMIS 8370 Stochastic Models

Model building with stochastic processes in applied sciences. Phenomena with uncertain outcomes are formulated as stochastic models and their properties are analyzed. Specific problems come from areas such as population growth, queueing, reliability, time series, and social and behavioral processes. Statistical properties of the models are emphasized. *Prerequisites:* STAT 5373 and graduate standing.

EMIS 8372 (STAT 6372) Queuing Theory

Queuing theory provides the theoretical basis for the analysis of a wide variety of stochastic service systems. The underlying stochastic processes are Markov and renewal processes. The course has two objectives: to cover the fundamentals of stochastic processes necessary to analyze such systems and to provide the basics of formulation and analysis of queuing models with emphasis on their performance characteristics. *Prerequisite:* EMIS 7370 or permission of instructor.

EMIS 8373 Integer Programming

A presentation of algorithms for linear integer programming problems. Topics include complexity analysis, cutting plane techniques, and branch-and-bound. *Prerequisite:* EMIS 8360 or 8371.

EMIS 8374 Network Flows

A presentation of optimization algorithms and applications modeling techniques for network flow problems. Topics include pure, generalized, integer, and constrained network problems, plus special cases of each, including transportation, assignment, shortest-path, transshipment, multi-commodity, and nonlinear networks. Case studies illustrate the uses of network models in industry and government settings.

EMIS 8378 Optimization Models for Decision Support

Study of the design and implementation of decision support systems based on optimization models. Course objectives: development of modeling skills, practice in the application of operations research techniques, experience with state-of-the-art software, and the study of decision support systems design and management. Topics include linear, integer, network, nonlinear, multi-objective, and stochastic optimization models for manufacturing, logistics, telecommunications, service operation, and public sector applications.

EMIS 8380 Mathematics of Optimization

The purpose of this course is to present at a high level of mathematical rigor the background topics that are necessary for a good understanding of the theoretical underpinnings of optimization. Many of these topics are traditionally higher-level linear algebra topics that are not present in undergraduate and most basic graduate linear algebra courses. Traditional supporting material covering real-valued functions in multidimensional space receive a thorough review. Theoretical material supporting linear programming and nonlinear programming will be presented. MATLAB will be used for examples and projects. Homework will consist primarily of the construction of proofs.

EMIS 8381 Nonlinear Programming

Topics include convexity analysis, nonlinear duality theory, Kuhn-Tucker conditions, algorithms for quadratic programming, separable programming: gradient and penalty methods. *Prerequisite:* EMIS 8371.

EMIS 8383 Advanced Logistics Networks

An advanced course focusing on several topics in logistics with a network design perspective. Topics include facility location-allocation, production/distribution system design, multi-commodity flow network design, vehicle routing, location/routing, and inventory lot-sizing models. The emphasis will be on mathematical modeling, analysis, and efficient solution methodologies. A good background in optimization (linear and integer programming) and some programming experience with C++ are very beneficial. *Prerequisites:* EMIS 8373 and EMIS 8374 or equivalent background.

All students must complete 9 credit hours (CH) in a concentration area.

Optimization

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Systems Engineering

EMIS 7300 Systems Analysis Methods

Introduction to modeling and analysis concepts, methods, and techniques used in systems engineering, design of products and associated production, and logistics systems and analysis of operational system performance. Specific topics include probabilistic and statistical methods, Monte Carlo simulation, optimization techniques, applications of utility and game theory, and decision analysis.

EMIS 7301 Systems Engineering Process

The discipline, theory, economics, and methodology of systems engineering is examined. The historical evolution of the practice of systems engineering is reviewed, as are the principles that underpin modern systems methods. The economic benefits of investment in systems engineering and the risks of failure to adhere to sound principles are emphasized. An overview perspective distinct from the traditional design and analytical-specific disciplines is developed.

EMIS 7303 Integrated Risk Management

An introduction to risk management based upon integrated trade studies of program performance, cost, and schedule requirements. Topics include risk planning, risk identification and assessment, risk handling and abatement techniques, risk impact analysis, management of risk handling and abatement, and subcontractor risk management. Integrated risk management methods, procedures, and tools will be examined.

EMIS 7305 Systems Reliability and Availability Analysis

This course is an introduction to systems reliability, maintainability, supportability and availability modeling and analysis with an application to systems requirements definition and systems design and development. Both deterministic and stochastic models are covered. Emphasis is placed on RMS/A analyses to establish a baseline for systems performance and to provide a quantitative basis for systems trade-offs.

Prerequisite: EMIS 7300 or equivalent.

EMIS 7307 Systems Integration and Test

The process of successively synthesizing and validating larger and larger segments of a partitioned system within a controlled and instrumented framework is examined. System integration and test is the structured process of building a complete system from its individual elements and is the final step in the development of a fully functional system. The significance of structuring and controlling integration and test activities is stressed. Formal methodologies for describing and measuring test coverage, as well as sufficiency and logical closure for test completeness, are presented. Interactions with system modeling techniques and risk management techniques are discussed. The subject material is based upon principles of specific engineering disciplines and best practices, which form a comprehensive basis for organizing, analyzing, and conducting integration and test activities.

Engineering Management

EMIS 7360 Management of Information Technologies

Defines the management activities of the overall computer resources within an organization or government entity. Consists of current topics in strategic planning of computer resources, budgeting and fiscal controls, design and development of information systems, personnel management, project management, rapid prototyping, and system life cycles.

EMIS 8361 Engineering Economics and Decision Analysis

Introduction to economic analysis methodology. Topics include engineering economy and cost concepts, interest formulas and equivalence, economic analysis of alternatives, technical rate-of-return analysis, and economic analysis under risk and uncertainty. Credit is not allowed for both EMIS 2360 and EMIS 8361. *Prerequisite:* Knowledge of introductory probability and statistics.

EMIS 8362 Engineering Accounting

An introduction to and overview of financial and managerial accounting for engineering management. Topics include basic accounting concepts and terminology; preparation and interpretation of financial statements; and uses of accounting information for planning, budgeting, decision-making, control, and quality improvement. The focus is on concepts and applications in industry today.

EMIS 8363 Engineering Finance

Develops an understanding of corporate financial decisions for engineers. Topics include cost of capital, capital budgeting, capital structure theory and policy, working capital management, financial analysis and planning, and multinational finance. *Prerequisite:* EMIS 8361 or a knowledge of time value of money.

EMIS 8364 Engineering Management

How to manage technology and technical functions from a pragmatic point of view. How to keep from becoming technically obsolete as an individual contributor and how to keep the corporation technically astute. This course will look at the management of technology from three distinct viewpoints: 1) the management of technology from both an individual and a corporate perspective, 2) the management of technical functions and projects, and 3) the management of technical professionals within the organization. *Prerequisite:* Graduate standing in engineering.

Information Engineering

EMIS 7351 Enterprise Fundamentals

An overview of business fundamentals, spanning the range of all functional areas: management, marketing, operations, accounting, information systems, finance, and legal studies.

EMIS 7352 Information System Architecture

The architecture of an information system (IS) defines that system in terms of components and interactions among those components. This course addresses IS hardware and communications elements for information engineers, including computer networking and distributed computing. It addresses the principles, foundation technologies, standards, trends, and current practices in developing an appropriate architecture for Web-based and non-Internet information systems.

EMIS 7353 Information System Design Strategies

This course surveys the fundamentals of software engineering and database management systems (DBMS) for information engineers. It covers the principles, foundation technologies, standards, trends, and current practices in data-centric software engineering and systems design, including object-oriented approaches and relational DBMS. The focus is on system design, development, and implementation aspects, and not the implementation in code.

EMIS 7357 Analytics for Decision Support

In a rapidly changing, complex environment, successful enterprises make mission-critical choices using decision-support systems, which apply analytical methods to massive organizational data sets to evaluate options, give insight to likely outcomes, and make recommendations of the “best” decisions to pursue. Course topics include 1) framing and understanding decision-making needs and processes to define, evaluate, and identify appropriate strategic, operational, or execution-level decisions; 2) identifying, collecting, and managing large-scale data needed for decision support; and 3) employing decision-support software in areas such as optimization and data mining. Credit is not allowed for both EMIS 7357 and EMIS 3309.

EMIS 7360 Management of Information Technologies

Defines the management activities of the overall computer resources within an organization or government entity. Consists of current topics in strategic planning of computer resources, budgeting and fiscal controls, design and development of information systems, personnel management, project management, rapid prototyping, and system life cycles.